AVIONICS

681

TELEQUIPMENT

E.S.L.

OSCILLOSCOPE
TYPE D66A

INSTRUCTION MANUAL

GEC-Marconi
AVIONICS

CENTRAL QUALITY DEPARTMENT

STANDARDS LABORATORIES

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PROCEDURE No: .....324.....

INSTRUMENT: ....SCOPE.....TYPE: ....D66A....

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TECHNICAL DATA AND SPECIFICATION OF THIS INSTRUMENT CAN BE FOUND IN SECTION.....1.....OF THIS MANUAL.

OPERATING INSTRUCTIONS CAN BE FOUND IN SECTION..2...OF THIS MANUAL.

PERFORMANCE CHECK/CALIBATION CAN BE FOUND IN SECTION...4...OF THIS MANUAL.

STANDARDS USED: TEKTRONIX SCOPE CALIBRATOR STD 38 & 39.
MARCONI GENERATOR STD 34. FLUKE DMM STD 48.
BALLANTINE RF MILLIVOLTMETER STD 33. PAT TESTER STD 30.

APPROVED .....
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ISSUE ...1..... DATE ...01/02/94..

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FOR SERVICING AND SPARES ENQUIRIES
SEE THE INFORMATION AT START OF SECTION 5.

TELEQUIPMENT is a registered trade mark of TEKTRONIX U.K. LTD.

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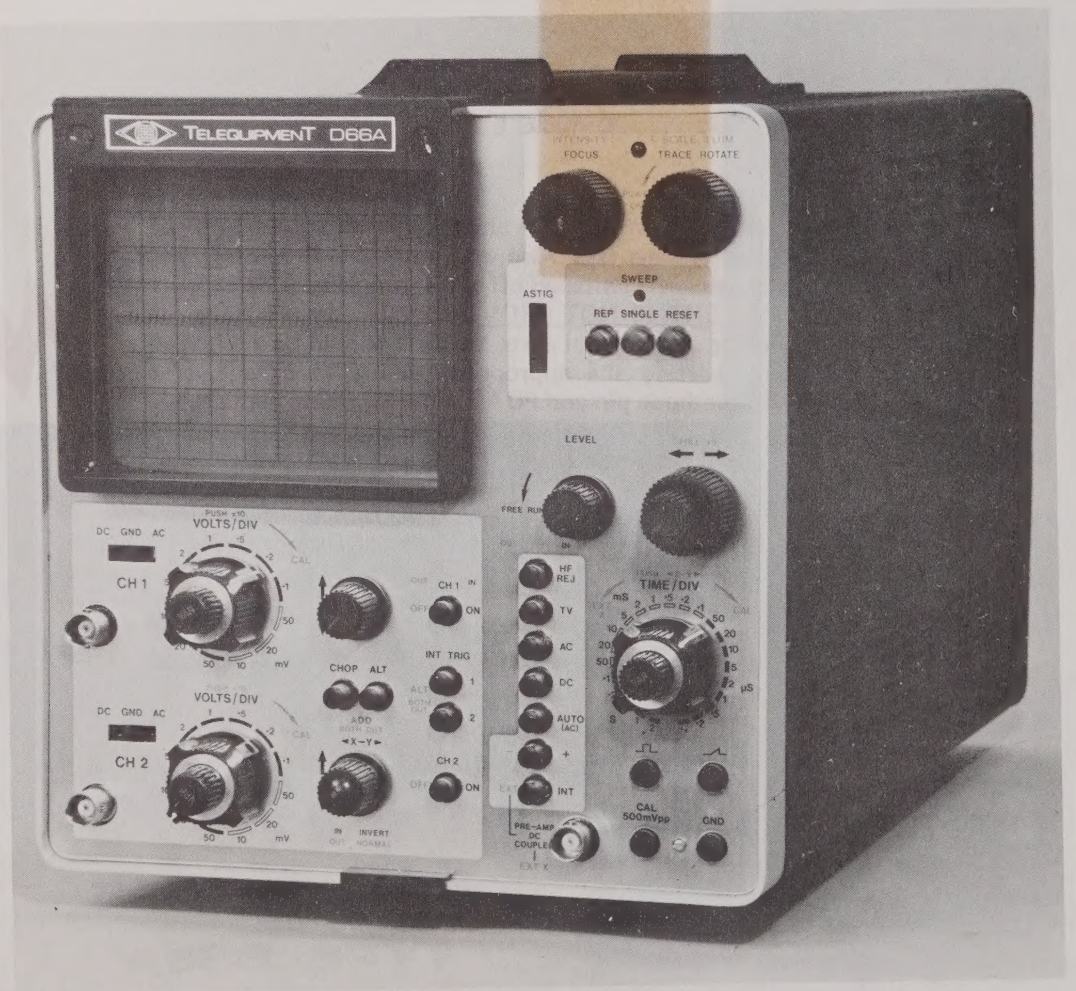

TELEQUIPMENT D66A
FOCUS
TRACE ROTATE
ASTIG
SWEEP
REP SINGLE RESET
LEVEL
FREE RUN
HF REJ
TV
AC
DC
AUTO (AC)
INT
TIME/DIV
CAL 500mVpp
GND
PRE-AMP DC COUPLE
DC GND AC
VOLTS/DIV
CH 1
CH 2
CHOP ALT
INT TRIG
ADD
INVERT

INTRODUCTION

The D66A is a 25 MHz, all solid state dual trace oscilloscope. An 8 x 10cm CRT provides a bright and clear display. The dual trace vertical system displays either channel separately, adds channels algebraically, alternates between channels or chops between channels at approximately 150kHz rate. Channel 2 can also be switched to become the horizontal amplifier to provide equal X – Y displays. The solid state design, using FET input circuitry, provides minimum drift and fast stabilization time.

The design of this instrument is subject to continuous development and improvement, therefore minor changes in detail from the information contained herein, may be incorporated. These changes which usually affect the Component Lists and Circuit Diagrams are described on Amendment Lists issued at regular intervals between reprints. Any Amendment List appertaining to this Manual is located in the pocket inside the back cover.

Throughout this Manual all references to the front panel controls are in full and in capital letters, e.g. INTENSITY.

In addition to the standard instrument, variations known as Options are available and are listed in Section 7 of this Manual.

If this instrument is returned for servicing the owner is requested not to send the Probe or Plug Assemblies unless they are suspect. This is to lessen the risk of damage during transit and to facilitate packaging.

CONTENTS

tle Page

ront Plate

troduction

ECTION Page

1 SPECIFICATION

Cathode Ray Tube 1/1
Vertical System 1/1
Horizontal System 1/1
Trigger 1/2
Outputs, Front Panel 1/2
Power Requirements 1/2
Size 1/2
Weight 1/2
Cooling 1/2
Temperature Limits 1/2

2 OPERATING INSTRUCTIONS

Pre-Operational Check 2/1
Line Voltage Operation 2/1
Function of Controls and Connectors 2/1
Input and Output Connectors 2/2
First Time Operation
Setting the Controls 2/2
Switch On 2/2
Use of Additional Facilities
Trigger Source 2/3
Slope 2/3
Mode 2/3
Level 2/3
Basic Applications
Use as a Monitor or Display 2/3
Peak to Peak Voltage Measurement 2/3
Voltage Measurement between two points on a Waveform 2/3
Instantaneous Voltage Measurement with reference to Ground 2/3
Instantaneous Voltage Measurement with reference to a DC Voltage 2/4
Time Duration Measurement 2/4
Frequency Measurement 2/4
Rise Time Measurements 2/4
Correction Formula for Fast Rise Time Waveforms . . 2/5

3 CIRCUIT DESCRIPTION

Block Diagram 3/1
Attenuators 3/1
Vertical Amplifier (Y Amplifier) 3/1
Sweep Trigger 3/2
Sweep Generator (Timebase) 3/2
Horizontal Amplifier (X Amplifier) 3/3
Unblanking Amplifier 3/3
CRT Circuit 3/3
Power Supplies 3/3

SECTION

4 MAINTENANCE AND CALIBRATION

Introduction . . . . .
Mechanical
Location of Pre-Set Controls . . . . .
Access to Interior . . . . .
CRT removal . . . . .
CRT fitting . . . . .
Calibration
Sweep speed check . . . . .
Gain check . . . . .
Probes . . . . .
Preliminary Procedure . . . . .
Sweep and Trigger . . . . .
Vertical Amplifier (supply variation) . . . . .
CRT . . . . .
Vertical Amplifier (DC & LF) . . . . .
Attenuator (adjustment) . . . . .
Horizontal Amplifier (gain and timing) . . . . .
Sweep (single shot) . . . . .
X – Y Mode (CH2 gain) . . . . .
Vertical Amplifier (Pulse response) . . . . .
Calibrator . . . . .

5 COMPONENT LIST

Electrical Components . . . . .
Mechanical Parts List . . . . .
Views 1 & 2

6 CIRCUIT DIAGRAMS

Fig

Block Diagram . . . . .
Attenuator . . . . .
Y Amp Input and Channel Switching . . . . .
Y Output and Trigger Pre-Amp . . . . .
Sweep Trigger . . . . .
Time base X-Amp & Blanking . . . . .
Time/Div . . . . .
CRT . . . . .
Power Supply . . . . .

7. STANDARD OPTIONS

Amendment Lists containing change information, if any, are located in the pocket at the rear of the manual.

TELEQUIPMENT TYPE D66A
OPERATING INSTRUCTIONS

To obtain a trace quickly and easily, operate the controls as follows:—

1. Push in these push-buttons —
   OFF-ON (CH1 & CH2), INT TRIG 1, CHOP, INT, +, AUTO(AC)
2. Set to mid-position —
   LEVEL INTENSITY FOCUS ASTIG,
   ↔ (horizontal position)
   ↕ (vertical position CH1 & CH2)
3. Set slide switches to GND (CH1 & CH2).
4. Set TIME/DIV to 5 ms and VARIABLE fully clockwise.

TELEQUIPMENT TYPE D66A
BETJENINGSANVISNING

For å få stråle pa skjermen på en rask og lettvint måte går man frem slik:

1. Trykk inn disse knappene —
   OFF-ON (CH1 & CH2), INT TRIG 1, CHOP, INT, + AUTO (AC)
2. Sett disse i midtstilling —
   LEVEL, INTENSITY, FOCUS ASTIG
   ↔ (horisontal posisjon)
   ↕ (vertikal posisjon CH1 & CH2)
3. Sett glidevendere til GND (CH1 & CH2).
4. Sett TIME/DIV på 5 ms og VARIABLE helt til høyre (med urviser).

TELEQUIPMENT TYPE D66A
BEDIENINGSVOORSCHRIFTEN

1. Deze drukkknoppen indrukken —
   OFF-ON (CH1 & CH2), INT TRIG IN, CHOP, INT, +, AUTO (AC)
2. In middenpositie plaatsen —
   LEVEL, INTENSITY, FOCUS, ASTIG,
   ↔ (horizontale positie)
   ↕ (verticale positie CH1 & CH2)
3. Schuifschakelaars op GND plaatsen (CH1 & CH2).
4. TIME/DIV op 5 msec zetten en VARIABLE geheel naar rechts draaien.
5. VOLTS/DIV op 0.2V zetten en VARIABLE geheel naar rechts draaien.

D66A TELEQUIPMENT
CONSEILS DE MISE EN SERVICE

Afin de faciliter la mise en service de cet oscilloscope, nous vous conseillons de procéder comme suit:

1. Enclencher les boutons —
   OFF-ON (CH1 et CH2), INT TRIG 1, CHOP, INT, +, AUTO (AC)
2. Placer à mi-course les boutons —
   LEVEL, INTENSITY, FOCUS, ASTIG,
   ↔ (position horizontale)
   ↕ (position verticale CH1 et CH2)
3. Pousser les commutateurs à glissière sur la position GND (CH1 et CH2).
4. Placer la commande TIME/DIV sur la position 5ms et le bouton VARIABLE à fond vers la droite.

BEDIENUNGSKARTE D66A

Die folgenden Schritte helfen Ihnen bei Inbetriebnahme des Gerätes eine Darstellung auf dem bildschirm zu erhalten.

1. Drücken Sie folgende Tasten:
   OFF-ON (Kanal 1 und Kanal 2) INT TRIG 1, CHOP, INT, +, AUTO (AC)
2. Stellen Sie die folgenden Bedienungselemente auf ihren mittleren Bereich ein:
   LEVEL, INTENSITY, FOCUS, ASTIG
   ↔ (Horiz. Position)
   ↕ (Vert Position, Kanal 1 und Kanal 2)
3. Stellen Sie die Eingangskopplungsschalter DC-GND-AC auf GND (Kanal 1 und Kanal 2).
4. Stellen Sie TIME/DIV auf 5 ms ein und VARIABLE auf Rechtsanschlag.
5. Wählen Sie mittels VOLTS/DIV 0,2V und stellen Sie VARIABLE auf Rechtsanschlag.

TELEQUIPMENT MODELLO D66A
ISTRUZIONI PER L'USO

Per ottenere una traccia rapidamente e facilmente vi consigliamo di posizionare i comandi come segue:

1. Premere questi pulsanti:
   OFF-ON (CH1 e CH2) INT TRIG 1, CHOP INT, +, AUTO (AC)
2. Porre in posizione intermedia:
   LEVEL, INTENSITY, FOCUS, ASTIG
   ↔ (posizione orizzontale)
   ↕ (posizione verticale CH1 e CH2)
3. Porre gli interruttori a slitta su GND (CH1 e CH2).
4. Porre il TIME/DIV a 5 ms ed il VARIABLE completamente in senso orario.

TELEQUIPMENT TYPE D66A
HANDLEDNING

För snabb och enkel inställning av strålarna, gör på följande sätt:

1. Tryck in dessa knappar —
   OFF-ON (Ch1 & CH2), INT TRIG 1, CHOP, INT, +, AUTO (AC)
2. Ställ dessa rattar i mittläge —
   LEVEL, INTENSITY, FOCUS, ASTIG,
   ↔ (horizontal position)
   ↕ (vertical position CH1 & CH2)
3. Ställ omkopplarna DC-GND-AC i läge GND (CH1 & CH2).
4. Vrid omkopplaren TIME/DIV till 5 mS och ratten VARIABLE maximalt medurs.

BETJENINGSVEJLEDNING FOR D66A

For at hjælpe Dem med start af instrumentet, anbefaler vi nedenstående procedure:

1. Tryk følgende knapper ind:
   OFF-ON (CH1 & CH2), INT TRIG 1, CHOP, INT, +, AUTO (AC0
2. Midtstil følgende knapper:
   LEVEL, INTENSITY, FOCUS, ASTIG,
   ↔ (Horizontal position)
   ↕ (Vertikal position CH1 & CH2)
3. Indstil skydeomskifterne til GND (CH1 & CH2).
4. Indstil TIME/DIV til 5 ms og VARIABLE helt med uret.

TELEQUIPMENT TIPO D66A
INSTRUCOES DE OPERACAO

Para obter o traço facil e räpidamente, deve operar da seguinte maneira:

1. Carregue nos seguintes Botões —
   OFF-ON (CH1 & CH2), INT TRIG 1, CHOP INT, +, AUTO (DC)
2. Rodar até uma posição intermédia —
   LEVEL, INTENSITY, FOCUS, ASTIG,
   ↔ (Posiçao Horizontal)
   ↕ (Posiçao vertical)
3. Coloque os comutadores de selecção de entrada em GND (CH1 e CH2).
4. Rode o TIME/DIV para 5 ms e o VARIABLE no máximo no sentido dos ponteiros do relógio.

5. Sett VOLTS/DIV på 0.2 V og VARIABLE helt til høyre (med urviser).
6. Forbind stikkontakten med lysnettet (230 V, 50 Hz) og kontroller at instrumentet er slått på med SCALE ILLUM. Grønn lampe skal lyse.
7. La instrumentet varmes opp i et par minutter, juster så horisontal og vertikal POSITION kontroller slik at 2 linjer vises på skjermen.
8. Juster INTENSITY og FOCUS slik at du får skarpest mulig tegning på skjermen.
9. Juster TRACE ROTATE inntil linjene på skjermen blir parallelle med de horisontale linjene i rutenettet.
10. Forbind den innebygde firkant-generatoren merket CAL 500 mV til inngangene CH1 & CH2. Sett vender DC-GND-AC til DC.

5. Set VOLTS/DIV to 0.2 V and VARIABLE fully clockwise.
6. Connect to line supply and check that power is switched on with SCALE ILLUM. Green lamp should glow.
7. Allow a few minutes to warm up, then adjust horizontal and vertical POSITION controls for a two-trace display.
8. Adjust INTENSITY and FOCUS to obtain a clearly defined display.
9. Adjust TRACE ROTATE until traces are parallel with the graticule horizontal lines.
10. Connect the line voltage frequency squarewave, example CAL 500 mV, to inputs of CH1 & CH2. Switch DC-GND-AC to DC.

5. Placer les commandes VOLTS/DIV sur la position 0,2V et les boutons VARIABLE à fond vers la droite.
6. Connecter l'appareil au réseau; la mise en service s'opère en tournant le bouton SCALE ILLUM; le voyant vert s'allume.
7. Attendre quelques minutes de mise à température; régler ensuite la position verticale et horizontale des deux traces.
8. Régler les commandes INTENSITY et FOCUS pour obtenir une représentation brillante et fine.
9. Régler la commande TRACE ROTATE pour aligner les traces avec les lignes horizontales du réticule.
10. Connecter la sortie CAL (signal carré de 500 mV) aux entrées CH1 et CH2. Placer la commande DC-GND-AC sur la position DC.

6. Netspanning aansluiten en controleren of het instrument is ingeschakeld met knop SCALE ILLUM. Groene lampje dient te branden.
7. Laat het instrument een paar minuten opwarmen en regel vervolgens de horizontale en verticale POSITION regelingen zodanig af tot twee sporen op het scherm verkregen zijn.
8. Regel INTENSITY en FOCUS zodanig af tot een helder en goed gedefinieerd beeld is verkregen.
9. Regel met behulp van de TRACE ROTATE knop het beeld zodanig af dat de beide sporen parallel zijn met de horizontale lignen van het raster.
10. Verbind de Calibratie Vierkantsgolf, b.v. CAL 500mV aan de ingangen van CH1 & CH2. Schakel DC-GND-AC naar DC.

5. Porre il VOLTS/DIV a 0,2V ed il VARIABLE completamente in senso orario.
6. Collegarsi alla rete di alimentazione ed accendere lo strumento con il comando SCALE ILLUM. La lampadina verde deve accendersi.
7. Lasciate che lo strumento si scaldi per qualche minuto, regolate quidi i comandi POSITION verticali ed orizzontali per visualizzare due tracce.
8. Regolare l'INTENSITY ed il FOCUS per ottenere delle tracce ben definite.
9. Regolare il TRACE ROTATE finche' le tracce sono allineate con le linee del reticolo.
10. Collegare un segnale ad onda quadra a frequenza di rete, AD esempio il CAL 500 mV, agli ingressi CH1 e CH2. Spostare l'interruttore DC-GND-AC su DC.

6. Schliessen Sie das Gerät an das Versorgungsnetz und schalten Sie es mittels SCALE ILLUM ein. Die grüne Kontrollampe sollte leuchten.
7. Warten Sie einige Minuten (Anwärmzeit) und stellen Sie die horizontalen und vertikalen Lageregler so ein, dass auf dem Bildschrim zwei Zeitablenkstrahle dargestellt werden.
8. Stellen Sie die Bedienungselemente INTENSITY und FOCUS so ein, dass die Ablenkstrahle mit genugender Helligkeit und guter Schärfe auf dem Bildschirm dargestellt werden.
9. Justieren Sie, falls notwendig, mittels TRACE ROTATE die Ablenkstrahle parallel zu den horizontalen Rasterlinien.
10. Schliessen Sie ein Rechtecksignal, z.B. CAL 500 mV, an die Eingänge CH1 und CH2. Schalter Sie nun DC-GND-AC auf die Position DC.

5. Indstil VOLTS/DIV til 0.2V og VARIABLE helt med uret.
6. Tilslut lysnettet og kontroller, at apparatet er tændt med SCALE ILLUM. Den grønne lampe skal lyse.
7. Lad apparatet varme op i 5 minutter. Juster derefter horisontal og vertikal POSITION knapperne til et to-spors display.
8. Juster INTENSITY og FOCUS for at få et klart defineret display.
9. Juster TRACE ROTATE til sporene er parallelle med graticule horisontale linier.
10. Tilslut kalibreringsspændingen på 500mV til indgangen af kanal 1 og 2. Drej DC-GND-AC til DC.

5. Vrid omkopplarna VOLTS/DIV till 0.2 V och ratten VARIABLE maximalt medurs.
6. Anslut nätsladden till vägguttaget och slå på instrumentet genom att vrida ratten SCALE ILLUM medurs. Kontrollera att gröna lampan lyser.
7. Vänta i fem minuter tills instrumentet är uppvärmt. Justera därefter med rattarna horisontal och vertikal POSITION så att två strålar syns.
8. Justera med rattarna INTENSITY och FOCUS så att strålarna blir skarpa och väl synliga.
9. Justera med ratten TRACE ROTATE så att strålarna blir parallella med horizontlinjerna.
10. Anslut kalibreringssignalen CAL 500 mV till ingångarna för CH1 & CH2. Ställ omkopplarna DC-GND-AC i läge DC.

5. Rode o VOLTS/DIV para 0,2 V e o VARIABLE no no máximo no sentido dos ponteiros do relógio.
6. Ligue a alimentação da rede, verifique se há tensão e se SCALE ILLUM está ligada. A lâmpada verde deverá acender.
7. Espere alguns minutos para o osciloscópio aquecer e ajuste os comandos horizontal e vertical do POSITION de modo a obter os dois traços.
8. Ajuste os comandos INTENSITY e FOCUS de modo a obter uma boa definição do traço.
9. Ajuste o TRACE ROTATE até que os traços sejam

SECTION 1

SPECIFICATION

1.1 CATHODE RAY TUBE (CRT)

Type	Single-gun with mesh PDA
Display area	8 x 10cm
Phospor	
Standard	P31
Special order	P7 or P11
Overall acceleration potential	10kV approximately
External intensity modulation	
Coupling	AC to Grid
Amplitude, peak to peak	50V maximum 15V for visible modulation at average brilliance
Time constant	10ms

1.2 VERTICAL SYSTEM

Operating modes	Channel 1 Channel 2 (normal or inverted) Channels 1 & 2 Alternate Chopped (at 150 kHz approx.) Added X – Y
3 dB bandwidth	
D.C. Coupled	D.C. – 25 MHz
A.C. Coupled	2 Hz – 25 MHz
Risetime X1	14 ns nominal
X10 A.C. or D.C. Coupled	15 MHz approx.
Max. Amplitude	7 div at 25 MHz
X – Y	Via CH1 with CH2 input selected via timebase switch as horizontal amplifier.
Bandwidth (–3dB)	D.C. – 1 MHz
Phase error	Less than 1° at 25 kHz
Deflection factors	
Calibrated – accuracy ± 5%	10 mV – 50V/div (12 ranges 1-2-5 steps)
Gain X10	1 mV – 5 V/div
Uncalibrated – with variable	Complete cover between steps and to 125 V/div
Signal Delay	200 ns
Input impedance	1 M Ω and 47 pF approx.
Maximum input – D.C., A.C. peak & Sum of	400 V peak

1.3 HORIZONTAL SYSTEM

Sweep generator	
Sweep rates	
Calibrated (23 ranges 1-2-5 steps)	2 s – 100 ns/div ± 5% without expansion; with X5 expansion ±7%. Fastest calibrated sweep increases to 20ns/div.
Uncalibrated (with variable)	Complete cover between steps and to 5 s/div
Single Shot	With lock-out
External horizontal amplifier	
3 dB bandwidth	D.C. – 1 MHz
Risetime	350 ns nominal
Deflection factors	1 V/div approx. 200 mV/div approx. (with X5 expansion)
Input impedance	100 kΩ and 30 pF approx.
Maximum input	400 V peak

1.4 TRIGGER

Coupling	A.C. or D.C.
Source	CH1, CH2, alternate and external
Internal	
HF REJ	10Hz – 50 kHz (approximate)
TV	TV field for sweep ranges 2s/div to 0.1ms/div TV line for sweep ranges 50 µs/div to 0.1µs/div. (line or field selected automatically by TIME/DIV)
AC (level)	10Hz to 25MHz
DC	DC to 25MHz
AUTO (AC)	40Hz to 25MHz
Sensitivity	
⩽15MHz	0.5 div ALT (1 div.
⩽25MHz	1 div ALT (1 div.
External	
Amplitude	250mV to + 15V at above frequencies
Impedance	100kΩ and 30 pF

1 .5 OUTPUTS, FRONT PANEL

Calibrator, peak to peak	500mV squarewave at supply frequency
Accuracy	2%
Sweep sawtooth	
Coupling	DC
Amplitude, peak	10V approximately
Minimum load	47kΩ
Gate out	
Coupling	DC
Amplitude, peak	500mV approximately

1.6 POWER REQUIREMENTS

Voltage	100 – 125 V in 5 V steps 200 – 250 V in 10 V steps
Frequency	48 – 400 Hz
Consumption	50 VA approx.

1.7 SIZE

Height	24 cm
Width	21 cm
Depth	44 cm

1.8 WEIGHT

11.5 kg

1.9 COOLING

Convection

1.10 TEMPERATURE LIMITS, ambient

Operating	0° C to + 40° C approx.
Non-operating	0° C to + 70° C approx.

SECTION 2

OPERATING INSTRUCTIONS

2.1 PRE-OPERATIONAL CHECK

Although this instrument is robust and is subjected to stringent checks before leaving the factory, it should be checked externally for possible damage. In the case of damage contact the carriers and your local Tektronix field office immediately.
Before switching the instrument on it is recommended that this chapter is read thoroughly and that some time be spent in becoming familiar with the controls.

2.2 LINE VOLTAGE OPERATION

A standard power cord is supplied and it will be necessary to fit a plug to suit the available line voltage source. The power cord connections are as follows:

Brown	Line
Blue	Neutral
Green/Yellow	Safety earth(Ground)

FOR SAFETY REASONS THE EARTH WIRE MUST BE CONNECTED, AND IF AN EXTENSION LEAD IS USED — ADEQUATE EARTH CONTINUITY MUST BE PROVIDED.

A voltage selector switch is provided on the rear panel and it should be set to the required line voltage source. The fuse is located on the rear panel and should be the correct value thus; 500mA for 100-125V;'; 250mA for 200 - 250V.

2.3 FUNCTION OF CONTROLS AND CONNECTORS

2.3.1 GENERAL

The controls are visible on the front panel and their functions are described by colour, method of operation, and purpose.
Abbreviations are used where possible for colour and method of operation thus:—

OR	=	Orange
BK	=	Black
P/P	=	Push in to set and push in to release.
ROT	=	Rotary, either smooth or stepped.
PUSH	=	Push in to set, but push in the adjacent button halfway to release.
P/R	=	Push in and release (non-locking).

2.3.2 CRT

INTENSITY (OR/ROT)	controls the light intensity of the display
FOCUS (BK/ROT)	controls the definition of the display
ASTIG (BK/ROT)	is used in conjunction with FOCUS for best overall definition.
TRACE ROTATE (BK/ROT)	rotates the traces about the horizontal axis of the CRT and is used to align the traces with the horizontal graticule divisions.
SCALE ILLUM/ ON-OFF (OR/ROT)	varies the intensity of the graticule illumination. Fully anticlockwise is POWER OFF.

2.3.3. HORIZONTAL DISPLAY

↔ (BK/ROT)	coarse position varies the location of the trace(s) in the horizontal axis, when **not** in the X — Y mode.
↔ (OR/ROT and Push-pull)	fine position provides the final accuracy for previous control. Push in for X1 gain Pull out for X5 gain and divide all sweep speed indications by 5. Note: In the X — Y mode X5 gain operates but not fine control.

2.3.4 SWEEP

TIME/DIV (BK/ROT)	sets the speed of the main sweep as marked, when VAR is fully clockwise and pulled out.
VAR (OR/ROT and Push-pull)	selects an intermediate speed between the TIME/DIV setting and the next lower by turning anticlockwise. Push in to select X — Y mode. In the fully anticlockwise position, switch off to permit EXT X mode.
LEVEL (BK/ROT)	selects the point on the signal waveform at which the sweep starts. In the fully anticlockwise position (including switch off)the sweep will FREE RUN.
REP (BK/P)	cancels SINGLE shot and restores normal repeating sweep mode;
SINGLE (BK/PUSH)	permits viewing or photographing a non-recurring signal.
RESET (BK/P/R)	if a recurring signal is applied in the SINGLE shot mode the sweep will run each time RESET is pressed, except in the X — Y mode.

2.3.5 TRIG MODE

TV (BK/PUSH)	facilitates triggering from TV field (frame) or line pulses, selected automatically by the TIME/DIV switch. The LEVEL control may require adjustment for best results. Polarity relates to the sense of video modulation.
HF REJ (BK/PUSH)	with a VOLTS/DIV setting of 1mV/div, or when in the CHOP mode, HF REJ should be pushed in if the input signal frequency is 10kHz or less
+ or — (BK/PUSH)	provide triggering from the positive or negative-going slope of a waveform.
AUTO (AC) (BK/PUSH)	provides automatic triggering at the mean level of the input waveform, when a suitable signal is applied. Absence of a triggering signal will cause the trigger to oscillate at a low repetition rate.
INT and EXT (BK/PUSH-PUSH)	enable the sweep to be triggered either internally from the vertical amplifier, or externally.
AD or DC (BK/PUSH-PUSH)	relate to the coupling of the trigger circuit. (See specification).

2.3.6 VERTICAL DISPLAY CH1 and CH2

OFF-ON (BK/PUSH-PUSH)	one switch per channel. If both channels are switched off, a straight line trace results which cannot be shifted by the marked control ↕ except when in the X — Y mode.
INT TRIG 1,2 (BK/PUSH)	selects internal triggering from either or both channels. When triggering ALT, both buttons must be released; the displays should be partially superimposed.

CHOP, ALT, ADD (BK/PUSH) provide three display modes for the vertical channels. In the CHOP mode, the channels are alternately switched on and off at a frequency of about 150kHz; this mode is suitable at the lower sweep speeds.
In the ALT mode, each channel is alternately displayed for the duration of a sweep; the ALT mode is preferable at higher sweep speeds.

(both push-buttons out) In the ADD mode, the display is the addition of both signals; but CH1 vertical position becomes trace shift (coarse) and CH2 vertical position becomes trace shift (fine).

↕ (BK/ROT) displaces each trace in the vertical direction except when both channels are off.
In the X – Y mode, irrespective of button settings, CH1 provides a vertical shift and CH2 a horizontal shift.

INVERT-NORMAL (BK/Push-pull) the setting of this button determines whether the CH2 signal is displayed in the same polarity as the input signal, or inverted. The inverted setting is used to display the difference between two signals in the ADD mode.

VOLTS/DIV (BK/ROT) provide twelve steps of attenuation of each channel input signal as marked when VAR is fully clockwise.

VAR (OR/ROT/PUSH-PUSH) selects an intermediate value of the VOLTS/DIV setting and the next lower by turning anticlockwise. Push in for X10, and out for X1.

DC-GND-AC (slide) selects the input signal coupling. In the DC position the signal from the INPUT connector is coupled directly to the attenuator.
In the AC position a capacitor is inserted in series.
In the GND position the input to the attenuator is grounded; this position enables the OV DC level of a trace to be ascertained.

2.3.7 INPUT AND OUTPUT CONNECTORS

1. INPUTS CH1 & CH2 each BNC connector is linked to the appropriate vertical channel attenuator via the DC-GND-AC switch.

EXT X BNC connector for either external triggering signals, or EXT X when VAR sweep speed control is in EXT X mode. The connector is DC coupled to both trigger and horizontal amplifier circuits. An external blocking capacitor may be required to remove the DC component. Input resistance is 100kΩ.
A X5 amplification of the horizontal display is obtained by pulling out ↔ (orange) control. If a dual-trace display is required on EXT X, the vertical display mode must be set to CHOP, but the ALT and ADD modes will provide only one trace.

Z MOD at the rear of the instrument, and connected via an isolating capacitor to the CRT grid. A positive-going signal is thus necessary to intensify the trace while a negative-going signal will blank it.

2. OUTPUTS
CAL 500mV pp socket provides a squarewave for checking the calibration of the vertical channels. The repetition rate is at supply frequency.

⎍ (GATE OUT) provides fast-edged positive going rectangular pulses of 0.5V peak to peak lasting for the duration of the sweep.
This is used for calibrating probes as follows:
1. Connect the probe to CH1 input.
2. Set VOLTS/DIV to 0.1 (10mV (X100).
3. Turn VAR fully clockwise.
4. Set TIME/DIV to 1ms.
5. Connect probe tip to the ⎍ s
6. Adjust the probe trimmer for th possible square corner on the le edge of the display.

If a 1kHz squarewave is used the a tude should be about 500mV and cycles of the waveform should b played. The above calibration proc should be followed by the applicati the X10 probe tip applied to the s wave generator output. The co tion should be checked if the pr transferred to INPUT 2.

⩘ (SAW TOOTH) provides a positive-going ramp wav when the sweep is running.
The resistance of an applied load s exceed 47kΩ to avoid loading the generator.

3. GND connected to the chassis of the i ment.

2.4 FIRST TIME OPERATION

2.4.1 SETTING THE CONTROLS

Set the front panel controls as follows:–

1. CRT

INTENSITY	Central
FOCUS	Central
ASTIG	Central
TRACE ROTATE	As set
SCALE ILLUM	Fully anti-clockwise to POWER OF

2. HORIZONTAL DISPLAY

(Coarse)	Central
(Fine)	Central and push in
TIME/DIV	5ms
VAR	Fully clockwise
LEVEL	Central
AUTO(AC)	Push in
+	Push in
INT	Push in

3. VERTICAL DISPLAY
CH1 & CH2

OFF-ON	Push in
INT TRIG 1	Push in
CHOP	Push in
↕	Central
NORMAL	Out
VOLTS/DIV	0.2V
VAR	Fully clockwise
DC-GND-AC	GND

2.4.2 SWITCH ON

1. Switch on by turning the SCALE ILLUM control c wise. Green lamp will glow.
2. Allow a short while for a two trace display to appear
3. Centralize the display using the ↔ and ↕ controls.
4. Adjust the INTENSITY control so that the trace i suitable light intensity for viewing.
5. Adjust the FOCUS control for the best trace definiti
6. Adjust TRACE ROTATE to align trace with horiz graticule lines.
7. Connect the supply frequency squarewave from the socket to both channel input sockets via 75Ω c cables.
8. Switch DC-GND-AC to DC.
9. If the supply frequency is 50Hz, 2.5 cycles of the brator waveform is displayed, each display being 2.5 in amplitude.
10. By now the user will be conversant with the operati the vertical controls so now they should turn to the s controls. Disconnect the CAL signals and connect a wave to the INPUTS. By turning the TIME/DIV co anti-clockwise in steps as far as it will go, it shou noticed that the sweep speed decreases.

11. Set the TIME/DIV knob to 1ms and observe the sweep speed.
12. Set the TIME/DIV knob to 5ms and note that the sweep should be slower.
13. Pull out the X5 control and the sweep speeds should be the same as 11.

2.5 USE OF ADDITIONAL FACILITIES

2.5.1 TRIGGER SOURCE

This control has been used in the INT position but it is possible to trigger from an external signal by connecting the signal to the EXT TRIG socket (BNC). The switch should be set to EXT.

2.5.2 SLOPE

The SLOPE switch allows triggering from a positive (+) going or negative ( ) going portion of the trigger signal. This is important when it is only required to observe a portion of a waveform, but where several cycles of a waveform are displayed the setting is often unimportant.

2.5.3 MODE

For the inspection or measurement of most waveforms the MODE control is used in the AC position. For the inspection of TV frame or TV line waveforms the switch should be set to TV. For TV field waveforms sweep ranges of 2 sec/div to 0.1ms/div should be used. For TV line waveforms sweep ranges of 50μs/div to 0.1μs/div are required.

2.5.4 LEVEL

By adjusting this control in AC or DC mode the triggering point can be varied over the whole of the waveform to 8 divisions with a minimum sensitivity according to specification. Turn fully anticlockwise and switch off so that the sweep will FREE RUN. In the absence of a triggering waveform or if the waveform does not meet the required minimum sensitivity an automatic bright line reference trace is displayed.

2.5.5 SINGLE SHOT

This facility allows a waveform to be photographed or viewed for closer analysis.

2.6 BASIC APPLICATIONS

The following are typical applications of Oscilloscope Type D66A. Only outline procedures are given to allow the user to adapt the method to individual requirements. Familiarity with the controls of the instrument as outlined in 2.3, 2.4 and 2.5 should enable these basic techniques to be applied to a wide variety of uses.

2.6.1 USE AS A MONITOR OR DISPLAY

One of the most frequent uses of an oscilloscope is as a monitor or display. By correct adjustment of the horizontal and vertical controls it is possible to display many cycles or a fraction of one cycle of a repetitive waveform. Generally it is desirable to limit the display to the centre 6 divisions vertically and in the case of a repetitive waveform to display 1 to 8 cycles within the centre 8 divisions horizontally.
It is possible to use the D66A instrument in this way to inspect a waveform for slope, over or undershoot and ringing. Where it is required to compare two waveforms, such as the waveforms entering and leaving a device, it is possible to feed the two waveforms to the two channels and display them either vertically one above the other, or superimposed.

2.6.2 PEAK TO PEAK VOLTAGE MEASUREMENT

AC – Symmetrical waveform.
1. Connect the waveform to be measured to CH1 or CH2 INPUT.
2. Set the appropriate VOLTS/DIV switch to display about 5 or 6 divisions of the waveform.
3. Set the AC-DC switch to AC.
4. Set the TIME/DIV switch to display several cycles of the waveform.
5. Use the ↕ control to set the lower edge of the waveform on one of the lower graticule lines so that the top edge of the waveform is in the graticule area.
6. Measure the vertical deflection of the signal on the screen.
7. Multiply the deflection in 6 by VOLTS/DIV setting and by the attenuation factor of any probe used.

EXAMPLE
Assume a vertical deflection of 5.3 divisions using a X10 attenuation probe and a VOLTS/DIV setting of 0.05 volts per division.

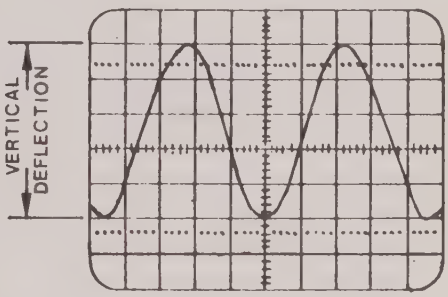
∴ Peak to Peak Voltage =

Vertical deflection × VOLTS/DIV (Setting) × Probe Attenuator factor

for our example

Peak to Peak voltage = 5.3 x 0.05 x 10

∴ Peak to Peak voltage = 2.65 volts.



Measuring Peak to Peak Voltage of a Waveform

2.6.3 VOLTAGE MEASUREMENT BETWEEN TWO POINTS ON A WAVEFORM

Proceed as in 2.6.2 substituting the two measurement points for the peaks and setting the lower point on one of the lower graticule lines.

2.6.4 INSTANTANEOUS VOLTAGE MEASUREMENT WITH REFERENCE TO GROUND

To make a measurement of the DC level at a specified point on a waveform use the following procedure:
1. Set the AC-DC switch of the selected channel to DC.
2. Set the TRIG switch to the channel selected.
3. Push AUTO (AC).
4. Connect the waveform to be measured to the INPUT of the selected channel.
5. If the waveform is repetitive use the TIME/DIV and ↔ controls to display at least one cycle.
6. Remove the INPUT signal and short circuit the INPUT to ground.
7. Set the trace to the lowest graticule line or other suitable reference line, using the ↕ control, if the point to be measured is positive. Set to highest or other suitable graticule line if the point to be measured is negative. AFTER THIS DO NOT ADJUST THE ↕ CONTROL.
8. Remove the INPUT short circuit and re-connect the signal.
9. Measure the distance in divisions from the reference line to the point to be measured.
10. Establish the polarity of the measured voltage. If the measurement point is above the reference line the voltage is positive. If the measurement point is under the reference line it is negative.
11. Multiply the measurement in 9 by the VOLTS/DIV switch setting and any probe attenuation factor.

EXAMPLE
Assume that the vertical distance measured is +2.7 divisions

with a VOLTS/DIV setting of 200mV and the probe attenuation factor is X1

∴ Instantaneous voltage =

$$\text{Vertical distance (divisions)} \times \text{Polarity} \times \text{VOLTS/DIV (Setting)} \times \text{Probe Attenuator factor}$$

For the values given
Instantaneous voltage = 2.7 x 1 x 0.2 x 1

∴ Instantaneous voltage = 0.54 Volts

2.6.5 INSTANTANEOUS VOLTAGE MEASUREMENT WITH REFERENCE TO A DC VOLTAGE

Proceed as in 2.6.4 but in step (6) set the switch to DC and feed in the reference voltage to the input. Step 8 will be to remove the reference voltage.

2.6.6 TIME DURATION MEASUREMENT

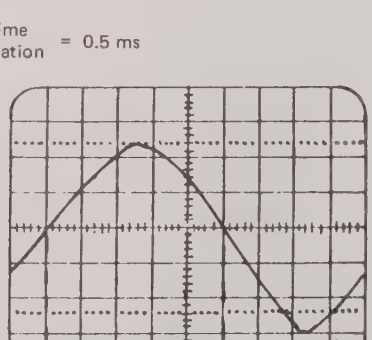
1. Connect the waveform to be measured to CH1 or CH2 INPUT.
2. Set the VOLTS/DIV switch to display a suitable vertical amplitude of the waveform.
3. Set the TIME/DIV and LEVEL controls to display the appropriate portion of the waveform to be measured over the maximum number of horizontal graticule divisions possible, keeping well inside the graticule limits.
4. Use the ↕ control to move the trace so that the measurement points are on the horizontal centre line.
5. The ↔ control is used to move the start of the measurement period to a convenient reference point.
6. Measure the distance (divs) between the measurement points.
7. Multiply the measurement in 6 above by the setting of the TIME/DIV switch and if the X5 control is used divide by 5. This gives the time duration.

EXAMPLE
If the distance between the points is 2.5 divisions with the TIME/DIV control on 0.2ms/div and the magnifier is not used,

$$\text{Time duration} = \text{horizontal distance (divisions)} \times \text{TIME/DIV setting}$$

$$\therefore \text{Time duration} = 2.5 \times 0.2 \text{ ms}$$

$$\therefore \text{Time duration} = 0.5 \text{ ms}$$



Measuring the Time Duration between points on a Waveform

2.6.7 FREQUENCY MEASUREMENT

The time duration technique shown in 2.6.6 can be used to establish the frequency of a periodically recurrent waveform. The starts of two adjacent cycles are taken as the measurement points and the time duration between these points established. The frequency is the reciprocal of the time duration.

EXAMPLE
If one cycle occupies 5 divisions with the time division control on 0.2 ms/div and the X5 magnifier is used

$$\text{Time duration} = \frac{\text{Horizontal Distance} \times \text{TIME/DIV (setting)}}{\text{Magnification}}$$

for the example

$$\text{Time duration} = \frac{5 \times 0.2 \text{ ms}}{5}$$

$$= 0.2 \text{ ms}$$

$$\text{Frequency} = \frac{1}{\text{Time duration}}$$

$$= \frac{1}{0.2 \times 10^{-3}}$$

$$= 5 \text{ kHz}$$

2.6.8 RISE TIME MEASUREMENTS

Rise time measurements employ the same basic techniq as time duration measurements. Rise time t is the t required by the leading edge of a waveform to rise from 1 to 90% of the waveform amplitude. The procedure is follows:

1. Connect the waveform to either input.
2. Set the AC/DC switch of the channel being used to appropriate position.
3. Set the appropriate VOLTS/DIV switch to display 4 8 divisions amplitude.
4. Centre the display about the centre horizontal line.
5. Set the trigger controls to obtain a stable display.
6. Set the TIME/DIV switch so that the 10% and 9 points of the waveform lie within the centre 8 divisi horizontally.
7. Determine the 10% point of the waveform and use ↔ and ↕ position controls to set this point to a c venient graticule point.
8. Determine the 90% point and estimate the horizo distance in graticule divisions between the 10% 90% points of the waveform.
9. Multiply the distance obtained in (8) by the setting the time divisions switch. If the sweep magnifier is u divide the result by 5. If the result is close to the time of the instrument it is necessary to apply a cor tion factor (see below).

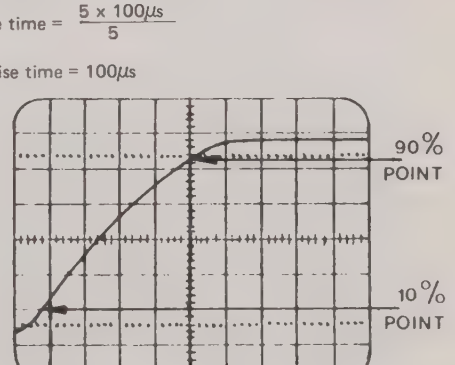
EXAMPLE
Assume that the horizontal distance between the 10% 90% points is 5 divisions and the TIME/DIV switch is se 100μs and the sweep magnifier is used,

$$\text{Rise time} = \frac{\text{horizontal distance (divs)} \times \text{TIME/DIV setting}}{\text{sweep magnification}}$$

for example

$$\text{Rise time} = \frac{5 \times 100\mu s}{5}$$

∴ Rise time = 100μs



Measuring Rise Time

2.6.9 CORRECTION FORMULA FOR FAST RISE TI WAVEFORMS

When the rise time of the oscilloscope is of the same or as the rise time of the waveform being measured it is

essary to apply a correction formula as follows:

$$\text{Actual Rise time (tra)} = \sqrt{\left(\text{Measured Rise time (trm)}\right)^2 - \left(\text{Oscilloscope Rise time (tro)}\right)^2}$$

EXAMPLE
Assume the rise time found by the method given in 2.6.8 is 40 ns. The oscilloscope rise time is approximately 23 ns. Applying the formula

$$\text{Actual rise time} = \sqrt{40^2 - 23^2}$$
$$= \sqrt{1600 - 529}$$
$$= \sqrt{1071}$$
$$\cong 33$$

NOTE It should not be necessary to apply the correction to waveforms having a rise time greater than 80 ns. Also the quoted rise time for the oscilloscope is the maximum figure and the actual rise time could be considerably better. This would mean that a calculated rise time would be in error. If it is necessary to work to greater accuracy it would be necessary to measure the bandwidth of the instrument and calculate the rise time as follows:—

$$\text{Rise time} = \frac{350}{\text{Bandwidth (MHz)}} \text{ ns}$$

SECTION 3

CIRCUIT DESCRIPTION

3.1 BLOCK DIAGRAM

3.1.1 This chapter will assist the reader to comprehend the circuitry of the D66A. By referring to the Block Diagram, Figure 1, the reader will see the interfaces of the various circuits and signal paths, which will be dealt with in detail later.

3.1.2 The signal is fed, via the Attenuator, to the Vertical Amplifier. Its description covers the function of the 'Y' input pre-amplifiers, Delay line driver and Output amplifiers, Channel switching multivibrator and trigger pre-amplifier. The output is fed to the 'Y' plates of the CRT with a portion of it being fed to the trigger network.

3.1.3 The Trigger circuit provides pulses of suitable amplitude and polarity to trigger the timebase from internally or externally derived waveforms.

3.1.4 The Timebase description deals with the ALT pulse and Sweep generators, Gating and Hold-off bistables. This stage determines the start and finish of each sweep and generates a sawtooth waveform for the horizontal amplifier.

3.1.5 The Horizontal amplifier description covers the 'X' output, which amplifies the internal sawtooth waveform or an external 'X' signal and applies it in push-pull to the 'X' plates of the CRT.

3.1.6 The Unblanking amplifier description covers the CHOP and Sweep retrace blanking amplifiers. The output being fed to the CRT g2 electrode.

3.1.7 The Calibrator is included with the description of the Power supplies; its function is to provide a calibrated peak to peak squarewave at power-line frequency, for the purposes of checking the vertical amplifier and timebase calibration.

3.2 ATTENUATORS

The signals to be observed are connected to the instrument by BNC sockets, via switch S901, reference Figure 2, to two identical attenuators each comprising four frequency-compensated resistive dividers with ratios of 100:1, 10:1, 5:1, and 2:1. These are switched, singly or in tandem, and C902, C905, C908 and C912 serve to standardize the input time constants; C904, C907, C911 and C914 compensate the respective dividers.

3.3 VERTICAL AMPLIFIER ('Y' AMPLIFIER)

The circuits of channel 1 (CH1) and channel 2 (CH2) are identical, with Zener diodes D604 and D611 providing stabilized positive and negative voltages, and D607 and D608 the shift voltages. CH1 is described below with reference to Figure 3, except where references are made to CH2.

3.3.1 The output from the attenuator is fed to the gate of TR601 via a protection circuit C601, C602, R601, R602a, R602b and R603, which prevents excessive voltage damaging the input FET.

3.3.2 TR601 and TR602 form a paraphase amplifier with their sources long-tailed through TR628. R624 provides variable gain control.
Compensation is provided by R625 for trace movement caused by varying R624. R622 compensates for supply voltage variation in conjunction with R626, R630, R632 and D604. Neutralization is effected by C604.

3.3.3 The output from the FET input stage is taken via emitter followers TR603 and TR604 to a gain stage TR605 and TR606. In the emitter circuit R617 sets the X1 channel gain and R618 the X10. The collector outputs are connected to the switching stage, TR609 and TR611, via emitter followers, TR607 and TR608. These provide, in push-pull, the channel trigger signal. The Miller capacities of the above gain stage are neutralized by C603 and C609.
In CH2 the emitter followers TR625 and TR624 provide the horizontal signal in the X – Y mode.

3.3.4 TR609 and TR611 form a long-tailed pair, with C606 and R614 providing H.F. compensation. Their output feeds a shunt feedback amplifier TR612 and TR613. The feedback resistors are split into pairs, R644, R650 and R658, R661 with the signal delay line compensation at one end, being provided by C621, R656, C619, R655, C618, R654 and C617, R653 connected between the junctions of the above pairs. The compensation at the other end, reference Figure 4 is provided by C751 and R751. The delay line is terminated at each end by R643, R659, R752 and R753.

3.3.5 The output from the delay line is fed to the emitter input of the output stage TR752 and TR753, and drives the 'Y' plates of the CRT Figure 8.
A portion of the output is taken via a balanced divider, R771, R773 and R772, R774 to switch S751 which switches either the above portion of the signal or the channel signal from the emitter followers, TR607 and TR608, to a long-tailed pair, TR755, TR757, which drive the trigger circuit.

3.3.6 The CH2 output, from TR625, TR624 also drives a separate long-tailed pair, TR754, TR756 which acts as a horizontal pre-amplifier in the X – Y mode. The X – Y gains are equalised with R787. The outputs from TR754, TR756 collectors drive the diode switching matrix in the horizontal output amplifier.

3.3.7 Channel switching is carried out by TR614 and TR615, which act as a bistable in the ALT mode and a free-running multivibrator in the CHOP mode, the current being provided via a long-tail TR616.

3.3.8 In the ALT mode a negative-going pulse coinciding with the start of the sweep flyback, is fed via D606 or D609, to the above bistable, causing it to switch. When TR614 is conducting, it passes current from the switching stage, TR609 and TR611, and allows the CH1 signal to pass to the shunt feedback amplifier, TR612 and TR613. At the same time TR615 is off, its collector rises to 16 V approx. taking the emitters of CH2 switching stage, TR626 and TR627 with it and so cutting off the current. Diodes D610 and D612 prevent the base-emitter junctions from breaking down in the reverse condition.

3.3.9 In the CHOP mode, R648 and R664 are returned to H.T. via R696, forming an astable multivibrator. The frequency is mainly determined by R648, R644, C613, C622, R647 R663 and R696.

3.3.10 In the ADD mode, the current supplied via TR616 is switched

off, so both TR614 and TR615 are non-conducting. Both switching stages, TR609, TR611 and TR626, TR627 are required to be on, so extra current is bled from the 115V line via R637 and R638. Current flows through the switching stages, via R646 and R662 through R673, to earth. Hence these signals are added at the bases of TR612 and TR613. CH2 signal can be inverted by switch, S604, to provide addition or subtraction of the two signals. Also in the ADD mode, CH2 ↕ becomes a very fine shift control. CH1 ↔ being the coarse shift control.

3.3.11 The table below shows the state of the switched components for all switch combinations, followed by a resumé on the part of circuit activated.
Condition A denotes R637, R638 connected to +110V.
Condition B denotes TR616 conducting.
Condition C denotes R673 connected to junction R646/R662.

		ALTernate			CHOP			ADD			X Y		
CH1	CH2	A	B	C	A	B	C	A	B	C	A	B	C
On	Off	No	Yes	No	No	Yes	No	No	Yes	No	No	No	No
Off	On	No	Yes	No	No	Yes	No	No	Yes	No	No	No	No
On	On	No	Yes	No	No	Yes	No	Yes	No	Yes	No	No	No
Off	Off	No	Yes	No	No	Yes	No	No	Yes	No	No	No	No

1. CH1 ON, CH2 OFF
TR614, TR609 and TR611 are conducting, this feeds the output of TR609 and TR611 to the bases of TR612 and TR613; TR626 and TR627 being reverse biased by the potential at TR615 collector.

2. CH1 OFF, CH2 ON.
TR615, TR626 and TR627 are conducting, so only the output of TR626 and TR627 may pass to the bases of TR612 and TR613; TR609 and TR611 being reverse biased by the potential at TR614 collector.

3. CH1 ON, CH2 ON. ALTERNATE
TR614 and TR615 are connected to form a bistable circuit. At the end of each sweep, a negative-going pulse appears at the junction of D606 and D609 which reverses the state of the bistable. Hence TR614 and TR615 conduct alternately and allow the outputs of CH1 and CH2 alternately, to reach the bases of TR612 and TR613.

4. CH1, CH2 CHOPPED
R648 and R664 are returned to H.T. via R696 to form an astable multivibrator, which free runs at 150 kHz approx. Thus the outputs of CH1 and CH2 are successively switched into TR614 and TR615 at 150 kHz. At each transition a pulse is fed from the emitters of TR612 and TR613 via C642 to the unblanking amplifier Figure 6, which blanks the CRT beam and thus provides automatic transient blanking in the chopped mode.

5. CH1, CH2 ADD.
The tail of the multivibrator and R633 are disconnected; TR614 and TR615 are non-conducting; R673 is connected to ground providing a current path for both channels simultaneously; TR609, TR611, TR626 and TR627 are conducting; extra current being fed to their collectors, via R637 and R638 from the +110V line, to maintain correct conditions. CH1 and CH2 may be used as a summing or differential (with INVERT pressed) amplifier. In this mode, the CH1 POSITION control provides a coarse shift, and CH2 POSITION control provides a very fine shift control (reference 3.3.10).

6. CH1 OFF, CH2 OFF.
TR614 and TR615 are non-conducting, preventing outputs from either CH1 or CH2 from reaching TR612 and TR613.

7. X – Y
When the X – Y switch is selected, the circuit is connected for X – Y operation as follows, regardless of any vertical amplifier mode switching. R641 is returned to ground, ensuring CH1 signal is connected to TR612 and TR613, and TR626 and TR627 are biased off; TR616 is non conducting and the junction of R646 and R662 is returned to H.T.

3.4 SWEEP TRIGGER

The bases of TR2 and TR3 trigger input amplifiers, refer Figure 5, are fed with internal or external trigger signal switch S3 which selects the source from either the colle of TR755 and TR757 in the vertical amplifier or TR1 i external trigger amplifier. S2 selects the polarity of the s on which the triggering occurs.

3.4.1 When switched in by S1e, R15, the LEVEL control varie base potentials of TR2 and TR3 in antiphase. This alter quiescent voltage on the base of TR4 and DC level of s required to trip TR4 and TR5.

3.4.2 When S1e is open in the AUTO position, feedback i ap from TR4 collector via R27 and R9 to TR2 base and TR5 collector via R26 and R23 to TR3 base. This feed causes TR2, TR3, TR4 and TR5 to oscillate in the absen a trigger input at a low frequency, primarily determine C11, R26 and R27. Input signals over-ride the above lation and the circuit locks to the input frequency. trigger sensitivity is set by R34. This adjusts the hysteres TR4 and TR5. R17 is set to provide a symmetrical opera of TR2 and TR3.

3.4.3 TR4 and TR5 form a Schmitt trigger and the constant a tude rectangular-wave output at the collector of TR differentiated by C15 and R38. The resulting bi-directi pulses are applied to the series clipper D1 which provide collector of TR68 in the sweep circuit with negative-g trigger pulse.
In the TV position S1, the signal at the collector of TR disconnected from TR4 base and connected instead to base. The output from the TR6 collector is differentiated then fed to the base of TR4. The bias of D4 is varied b TIME/DIV switch so that the Schmitt TR4 and TR5 w switched by either TV line or field pulses.

3.4.4 In the HF REJ condition, R48 and C17 are connecte TR4 base, and these serve to attenuate the HF compone signals fed to that point.

3.5 SWEEP GENERATOR (TIMEBASE)

The sweep generator, reference Figure 6, consists of a M integrator TR71 and emitter follower TR72; and tw stables, a gating bistable TR66, TR68 and hold-off bis TR73, TR74, connected between the Miller output input.

3.5.1 Initially, for an incoming trigger pulse to fire the s the following conditions apply: –
Diodes D67, D68 and TR69 are conducting and clamp drain of TR71 at +2.5V approx. The hold-off bistable is with TR73 off, TR74 on and the gating bistable with T on, TR68 off.

3.5.2 A negative-going trigger pulse causes TR66 to switch TR68 on, and D66 to conduct. Hence current flo through R84 diverts from D67, D68 to D66. This circuits D67, D68 and releases the gate of TR71. TR71 starts to rise, due to Miller action, taking TR72 base emitter with it and cutting off TR69. This rising sawt voltage passes through D71 until eventually TR73 becomes sufficiently positive to switch the bistable Hence TR74 switches off, TR73 on and the negative vo step at TR73 collector causes TR68 to switch off and T on. TR68 collector goes positive, switching D66 off, and D68 on and starting the flyback.

3.5.3 Current flows through R84, D67, D68 into the ti capacitor C_t to commence flyback. When TR72 em has fallen sufficiently taking TR69 emitter with it then T conducts and clamps C_t at the initial start potential. potential is determined by the resistor ratios R85, R86 R94 and R95.

3.5.4 During the flyback period, D71 is off due to the charg

the hold off capacitor C_h. This charge leaks away through R104, R105, R106, R107 and R112 until eventually TR73 switches off, TR74 on and the initial conditions (3.5.1) are restored.

3.5.5 When the sweep is switched to a single-shot mode, TR73 base is prevented from switching at the end of the flyback and is clamped by diode D72. The bistable is switched over by pressing RESET. this applies a negative-going pulse to TR73 base and causes the collector current to switch off and TR74 to conduct.
The circuit is then ready for the next incoming trigger pulse to fire the sweep.

3.5.6 When S63 is switched to FREE RUN, it is open. D65 conducts and the bias of TR66 is adjusted so that the negative pulses are of insufficient amplitude to trigger the bistable TR66, TR68. The trace then free runs. In the normal triggered operation S63 is closed, and the potential at the junction of R73 and R90 is such that D65 is reverse biased. TR66 now responds to the negative trigger pulses at its base, and the trace locks.

3.6 HORIZONTAL AMPLIFIER (X-AMPLIFIER)

The horizontal amplifier reference Figure 6, consists of a pre-amplifier TR76, followed by a cascade connected long tailed pair output stage, TR77, 78, 79 and 81.

3.6.1 The pre-amplifier TR76, is a shunt feedback stage in which the sweep and shift voltages are mixed via R103, R122 on its base. In the EXT X position, TR1 is connected in place of the sweep signal. This converts the external high impedance input into a low impedance suitable for mixing with the shift voltage at TR76 base. The TR76 collector output is fed to the base of TR78 via diode D76. TR78 and TR79 form the bottom half of a cascade amplifier, their collectors driving the emitters of TR77 and TR81; tail current being supplied via TR82.

3.6.2 Gain control is provided, in the X1 condition by R132; in the X5 position by R131. The output from TR77 and TR81 collectors driving the CRT X plates.

3.6.3 In the sweep and EXT X positions D76, D81, D74, D78 are conducting, D77, D82, D79, D75 are off. The signal is fed to the base of TR78 via D76 and DC to the base of TR79 via D81.

3.6.4 In the X — Y mode D74 and D78 are not conducting, D75 and D79 are conducting allowing the push pull output from CH2 to be fed to the bases of TR78 and TR79. D76 and D81 are not conducting, D77 and D82 are conducting, shorting out the signal on TR76 collector.

3.7 UNBLANKING AMPLIFIER

The amplifiers for unblanking comprise TR65, TR67 and for chopped blanking TR62 and TR64, reference Figure 6.

3.7.1 In the absence of a sweep TR66 conducts, causing current to flow through TR65 making TR65 collector, TR67 emitter and the CRT g2 electrode negative with respect to the CRT a1 electrode, blanking the trace.

3.7.2 When the sweep starts TR66 switches off; TR65 current ceases; hence its collector goes to H.T. causing TR67 emitter and CRT g2 to follow. The potentials of a1 and g2 electrodes are equalized so unblanking the trace.

3.7.3 Chopped blanking pulses are fed from the TR616 collector (figure 3), via C642, to the cascade circuit TR62 and TR64, which amplifies the pulse.
The collector of TR64 falls, allowing D64 to conduct and pass the blanking pulses, via TR67 to the CRT g2 electrode to blank the trace.

3.8 CRT CIRCUIT

3.8.1 The cathode is connected, reference Figure 8 via a zener diode, D301, across which the INTENSITY control is connected to the H.T. supply. This allows the INTENSITY control circuit to be low impedance.

3.8.2 Unblanking pulses are connected to g2. a1 is taken to H.T.

3.8.3 Variable voltages are supplied to a3 and S for optimum astig and geometry adjustment.

3.9 POWER SUPPLIES

3.9.1 A centre tapped low voltage winding is full wave rectified and R-C smoothed to provide ± 12.5 volts and ± 14 volts.

3.9.2 An H.T. winding is voltage doubled using a full wave doubler then R-C smoothed to provide the positive H.T. supply.

3.9.3 A high voltage winding is full wave voltage doubled to provide the EHT negative supply for the CRT and a voltage quadrupler provides the high voltage PDA supply for the CRT.

3.9.4 A 500 mV calibrator waveform is supplied by clipping the supply waveform and referring the amplitude to a zener diode.

SECTION 4

MAINTENANCE AND RE-CALIBRATION

Care must be taken not to touch high voltage tags. The instrument must be disconnected from the line voltage supply before removing the case, and whenever possible during servicing.

4.1 INTRODUCTION

4.1.1 The solid-state design of the instrument makes frequent adjustment of the internal preset components unnecessary. The appropriate part of the Calibration Procedure should be performed whenever the instrument fails to meet its specification or whenever a defective component is replaced. The Circuit Description, Section 3, will assist is deciding which part of the circuit requires adjustment.

4.1.2 The internal 500mV calibrator allows the accuracy of the vertical amplifiers to be checked against an external sinewave or marker pulse source.

4.2 MECHANICAL

4.2.1 **LOCATION OF PRESET CONTROLS**
Attenuator trimmers are accessible from the left hand side, front, after the covers have been removed. PC 110A and PC 112 which carry the circuits for the timebase, power supplies and storage are situated on the right hand side; PC 115, the vertical amplifier is on the left hand side. The boards are marked with a legend to facilitate component identification.

4.2.2 **ACCESS TO INTERIOR**
The cabinet sides are removed as follows:
1. Disconnect the power supply.
2. Loosen the two handle securing screws.
3. Ease the top of each side outwards.
4. Unhook the bottom of each side from the locating slots. The chassis base cover plate is secured by six fixing screws, one at each corner and one half-way along each side.

4.2.3 **CRT REMOVAL**
1. Remove both cabinet sides, as described above.
2. Remove the rear cover (four screws).
3. Unplug the PDA cap.

CAUTION: Earth both male and female connectors on the cap and CRT respectively, ensuring that the residual charge has been fully dissipated.

4. Unplug the 12-pin CRT base connector.
5. Unplug trace rotation coil plug, from the left-hand board.
6. Unplug five CRT side pin connectors.
7. Remove the three screws holding the mumetal screen.
8. Remove the CRT and screen from the instrument by moving the CRT and screen towards the rear to clear the front panel; moving the forward end of the CRT to the left.
9. Remove adhesive tape and rear location moulding from the CRT.
10. Remove CRT from screen.
11. Remove trace rotation coil and rubber packing from CRT.

4.2.4 **CRT FITTING**
Reverse the order detailed above 4.2.3 Ensure that the CRT forward end is located in the rubber moulding behind the front panel. If the trace rotation control does not provide an adequate range of adjustment reverse the trace rotation plug.

4.3 CALIBRATION

4.3.1 The following procedure enables a full calibration of the instrument to be accomplished. If any operations are carried out in isolation, regard should be paid to the risk of interaction with other adjustments also to control settings and waveforms applied in earlier steps.
The following tools and equipment are required:—
1. Standard servicing tool kit.
2. Trimming tool, low capacitance (for preset capacitors and potentiometers).
3. Amplitude Calibrator, approximately 1kHz squarewave providing outputs of 50mV to 50V ± 0.25%.
4. Time Calibrator, providing markers of amplitude. between 50mV and 10V, 1μs to 1ms ± 0.1%.
5. Squarewave Generator, providing a terminated 1MHz signal of approximately 500mV, rise time less than 10ns.
6. Sinewave Generator, providing 50kHz to 10MHz signal amplitude up to 25V.
7. Monitor Oscilloscope with X10 passive probe.
8. Digital DC Voltmeter with input impedance of not less than 1MΩ.
9. Composite TV video signal source.
10. Voltmeter (internal resistance not less than 20kΩ/volt).
11. Ammeter 0-500mA DC ± 3%.
12. Coaxial connecting leads and terminating load suitable for matching coax impedance.
13. X1 probe (available as an accessory).
14. X10 probe (available as an accessory).
15. Variable Transformer with ± 10% facility.

4.3.2 **SWEEP SPEED CHECK**
1. Switch CH1 and CH2 on.
2. Set VOLTS/DIV to 100mV.
3. Turn VAR fully clockwise and release for X1.
4. Set DC-GND-AC to DC.
5. Push ⟷ for X1.
6. Set TIME/DIV to 10 ms.
7. Turn VAR (speed) fully clockwise.
8. Connect INPUT 1 & 2 to CAL.
9. Adjust LEVEL for locked display.
10. Check Sweep Speed = 1 cycle/2divs. for 50 Hz supply
= 3 cycles/5divs. for 60 Hz supply
for 400 Hz supply set TIME/DIV to 1 ms
check Sweep Speed = 2 cycles/5 divs.

4.3.3 **GAIN CHECK**
1. Repeat 1 through 5 above.
2. Connect CAL to INPUT 1.
3. Adjust CH1 POSITION, Trigger and Sweep controls for convenient display.
4. Check amplitude = 5 divs. if incorrect adjust R617.
5. Connect CAL to INPUT 2.
6. Adjust CH2 POSITION, Trigger and Sweep controls for convenient display.
7. Check amplitude = 5 divs., if incorrect adjust R691.

NOTE: VARs must remain fully clockwise.

4.3.4 **PROBES**

Reference 2.3.7, sub-para 2, GATE OUT.

4.3.5 **PRELIMINARY PROCEDURE**

1. With the instrument disconnected from the power supply, remove the cabinet sides as detailed in 4.2.2
2. Insert the voltage-selector plug in the rear panel with the arrow indicating the nominal voltage of the local A.C. supply or the nearest value to it.
3. Connect the power cable to the variable transformer. The cores of the cable are alternatively colour-coded as follows.

LINE	NEUTRAL	EARTH Chassis
Brown Black	Blue White	Green/Yellow Green

4. Set all preset pots to mid position.
5. Set front-panel controls as follows:

↕ (CH1 & 2)	Central
OFF-ON (CH1 & 2)	OFF
ALL VAR	fully clockwise
LEVEL	fully anticlockwise
↔ (Coarse)	Mid position
↔ (fine)	Central and pushed in
All push buttons	released

6. Connect the Variable Transformer to the power supply, switch on power supply and allow oscilloscope to warm up.
7. Adjust the Variable Transformer to give the same voltage as that indicated by the voltage-selector plug.
8. Adjust INTENSITY for reasonable setting.
9. Adjust FOCUS and ASTIG.

4.3.6 **SWEEP AND TRIGGER**

1.0 To set auto and trigger sensitivity R17 and R34, **PC110A.**

1.1 Set VAR (sweep) to EXT X.
1.2 Release all Buttons
1.3 Release EXT TRIG, push in AUTO (AC).
1.4 Set CH1 and CH2 DC-GND-AC to GND.
1.5 Connect Test Oscilloscope to TR3 collector tag 62. PC110A. (Reference Figure 10).
1.6 Set Oscilloscope to 0.1 volts/div and 20 ms/div.
1.7 Turn R34 fully anti-clockwise.
1.8 Adjust R17 to the centre of the range over which a continuous oscillation, at 1 MHz approximately, is observed on the Test Oscilloscope.
1.9 Turn R34 slightly clockwise.
1.10 Reset R17 to the centre of the oscillation range.
1.11 Repeat 1.7 through 1.9 until the oscillation develops into a triangular waveform at 20 Hz approx.
1.12 Adjust R17 and R34 to give a symmetrical waveform of 70 mV peak to peak.

2.0 To set gate potential: R93. PC110A.

2.1 Connect Test Oscilloscope to Tag 21, PC110A.
2.2 Turn R72 fully clockwise.
2.3 Turn VAR (sweep) fully clockwise.
2.4 Adjust R93 for 2 V negative potential with respect to GND.

3.0 To set sweep length: R106. PC110A.

3.1 Connect Test Oscilloscope to Tag 23, PC110A.
3.2 Turn R72 fully anticlockwise.
3.3. Adjust R106 for a total sweep amplitude of 10 V.
3.4 Disconnect Test Oscilloscope.
3.5 Push in EXT TRIG.
3.6 Set CHOP ADD ALT to ALT.

4.0 To set R72 (PRESET STABILITY)

4.1 Set TIME/DIV to 1ms.
4.2 Push in TV.
4.3 Apply a composite TV waveform to CH1 input.
4.4 Turn LEVEL to mid-position.
4.5 Turn R72 anticlockwise until trace free runs, then clockwise until trace just locks.

4.3.7 **VERTICAL AMPLIFIER (supply variation compensation)**

1.0 To set CH1 supply variation: CH1 on, CH2 off, PC115.

1.1 Set VOLTS/DIV to 10 mV.
1.2 Set DC-GND-AC to DC.
1.3 Connect Calibrator to INPUT 1.
1.4 Set calibrator to 5 mV peak to peak, 1 kHz squarewave.
1.5 Press VAR for X10 gain.
1.6 Set ↕ to centre of range.
1.7 Adjust R642 until trace appears.
1.8 Set R618 for 5 div deflection approximately.
1.9 Adjust LEVEL for free-run trace.
1.10 Set DC-GND-AC to GND.
1.11 Adjust R642 to centralize trace.
1.12 Reduce supply voltage by 10%.
1.13 Note direction, if trace moves in the vertical axis.
1.14 Adjust R622 slightly to move trace in the direc noted in 1.13 above.
1.15 Increase supply to normal.
1.16 Adjust R642 to centralize trace.
1.17 Repeat 1.12 through 1.16 until trace movemer reduced to a minimum, when the Variable Tr former setting is varied between ± 10%.

2.0 To set CH2 supply variation: CH1 off, CH2 PC115.

2.1 Set VOLTS/DIV to 10 mV.
2.2 Set DC-GND-AC to DC.
2.3 Connect Calibrator to INPUT 2.
2.4 Set Calibrator to 5 mV peak to peak 1 kHz squ wave.
2.5 Press VAR for X10 gain.
2.6 Set ↕ to centre of range.
2.7 Adjust R669 until trace appears.
2.8 Set R693 for a 5 div deflection approximately.
2.9 Adjust LEVEL for free-run trace.
2.10 Remove signal by earthing input.
2.11 Adjust R669 to centralize trace.
2.12 Reduce supply voltage by 10%.
2.13 Note direction, if trace moves in the vertical a
2.14 Adjust R697 slightly to move trace in the direc noted in 2.13 above.
2.15 Increase supply to normal.
2.16 Adjust R669 to centralize trace.
2.17 Repeat 2.12 through 2.16 until trace movemer reduced to a minimum, when the setting is va between ± 10%.
2.18 Disconnect Calibrator.

3.0 To check supply fluctuation.

3.1 Switch CH1 on and check CH2 is on.
3.2 Alter variable transformer setting rapidly betw ± 5%.
3.3 Check that both traces do not bounce more t 1mm. If bounce is excessive repeat Op 1.0 and above.

4.3.8 **CRT (Geometry)**

1.0 To set geometry R301, PC112.

1.1 Connect Signal Generator to INPUT 1.
1.2 Set Signal Generator to at least 100 kHz sinewave
1.3 Switch CH2 off.
1.4 Set TIME/DIV for close spaced raster, 10 sinewa div approximately.
1.5 Push ↔ (fine) for X1 gain.
1.6 Set CH1 VOLTS/DIV to 10 mV.
1.7 Adjust Signal Generator's amplitude to provid raster with top and bottom edges just visible in display area.
1.8 Adjust R301 for minimum curvature at the edge the raster.
1.9 Disconnect the Signal Generator.

4.3.9 **VERTICAL AMPLIFIER (DC and LF setting)**

1.0 To set CH1 VAR and ↕ balance: R625 and R PC 115.

1.1 Check CH1 on, CH2 off.
1.2 Set VAR fully clockwise.
1.3 Set VOLTS/DIV to 10mV.
1.4 Set DC-GND-AC to GND.
1.5 Adjust ↕ to align trace with graticule centre line.
1.6 Push VAR for X10 gain.
1.7 Adjust R642 to centralize trace.

1.8 Release VAR for X1 gain.
1.9 Repeat 1.5 through 1.8 until no trace movement occurs when operating VAR.
1.10 Push VAR for X10 gain.
1.11 Turn VAR fully anticlockwise.
1.12 Adjust R625 to centralize trace.
1.13 Turn VAR fully clockwise.
1.14 Repeat 1.11 through 1.13 until there is no movement when VAR is turned through its range.

2.0 To set CH2 ↕ balance: R669. PC115
2.1 Switch CH2 on.
2.2 Push both VAR for X10 gain.
2.3 Set both DC-GND-AC to GND.
2.4 Turn both VAR fully clockwise.
2.5 Set CHOP-ADD-ALT to ALT.
2.6 Centralize both traces.
2.7 Set CHOP-ADD-ALT to SUM.
2.8 Adjust R669 to centralize trace.
2.9 Repeat 2.5 through 2.8 until no trace movement occurs.

3.0 To set CH2 VAR balance: R701. PC115.
3.1 CH1 off, Check CH2 is on.
3.2 Set VAR fully clockwise.
3.3 Set VOLTS/DIV to 10 mV.
3.4 Set DC-GND-AC to GND.
3.5 Adjust ↕ to align trace with graticule centre line.
3.6 Push VAR for X10 gain.
3.7 Turn VAR fully anticlockwise.
3.8 Adjust R701 to centralize trace.
3.9 Repeat 3.6 through 3.8 until there is no movement when VAR is turned through its range.

4.0 To set CH1 X1 gain: R617. PC115
4.1 Switch CH1 on, CH2 off.
4.2 Set VOLTS/DIV to 10 mV.
4.3 Release VAR for X1 gain.
4.4 Press INT TRIG 1.
4.5 Set TIME/DIV to 1 ms.
4.6 Set DC-GND-AC to DC.
4.7 Connect Calibrator to INPUT 1.
4.8 Set Calibrator to 50 mV peak to peak 1 kHz squarewave.
4.9 Adjust R617 to give 5 div amplitude.

5.0 To set CH1 X 10 gain: R618. PC115.
5.1 Set Calibrator to 5 mV peak to peak.
5.2 Push VAR for X10 gain.
5.3 Adjust R618 to give 5 div amplitude.

6.0 To set CH2 X1 gain: R691. PC115
NOTE: Operations 6.0 and 7.0 assume that CH1 gain, Ops 4.0 and 5.0 have been accurately set.
6.1 Switch CH1 off, CH2 on.
6.2 Set both VOLTS/DIV to 10 mV.
6.3 Turn VAR fully clockwise.
6.4 Set DC-GND-AC to DC.
6.5 Release VAR for X1 gain.
6.6 Press INT TRIG 2.
6.7 Set CHOP-ADD-ALT to ALT.
6.8 Adjust ↕ to centralize trace.
6.9 Connect Calibrator to INPUT 2.
6.10 Set Calibrator to 50 mV peak to peak 1KHz squarewave.
6.11 Adjust R691 for 5 div amplitude.
6.12 Switch CH1 on.
6.13 Connect Calibrator to INPUT 1 & 2.
6.14 Check channels for identical traces.

7.0 To set CH2 X 10 gain: R693. PC115
7.1 Set Calibrator to 5 mV peak to peak.
7.2 Push both VAR for X10 gain.
7.3 Adjust R693 for 5 div amplitude.
7.4 Check channels for identical traces.

8.0 To set CH1 input and neutralizing capacities: C601 and C604. PC115
8.1 Connect Calibrator to INPUT 1.
8.2 Switch CH1 on, CH2 off.
8.3 Press INT TRIG 1.
8.4 Turn VAR fully clockwise.
8.5 Set VOLTS/DIV to 10 mV.
8.6 Release VAR for X1 gain.
8.7 Set DC-GND-AC to DC.
8.8 Set Calibrator to 50 mV, 1kHz squarewave.
8.9 Adjust C604 for square corner with a non-capacitive trimming tool.
8.10 Turn VAR fully anticlockwise.
8.11 Adjust C601 for square corner (increase signal amplitude if required).
8.12 Turn VAR fully clockwise.
8.13 Repeat 8.8 through 8.11 until a square corner is maintained at the extreme positions of the VAR control.

9.0 To set CH2 input and neutralizing capacities: C634 and C636. PC115
9.1 Connect Calibrator to INPUT 2.
9.2 Switch CH2 on, CH1 off.
9.3 Press INT TRIG 2.
9.4 Turn VAR fully clockwise.
9.5 Set VOLTS/DIV to 10 mV.
9.6 Release VAR for X1 gain.
9.7 Set DC-GND-AC to DC.
9.8 Set Calibrator to 50 mV 1 kHz squarewave.
9.9 Adjust C636 for square corner with a non-capacitive trimming tool.
9.10 Turn the VAR fully anticlockwise.
9.11 Adjust C634 for square corner (increase signal amplitude if required).
9.12 Turn VAR fully clockwise.
9.13 Repeat 9.8 through 9.11 until a square corner is maintained at the extreme positions of the VAR control.

4.3.10 ATTENUATOR (adjustment)
1.0 To set CH1 Attenuator compensation. PC73
1.1 Switch CH1 on.
1.2 Connect Calibrator to INPUT 1.
1.3 Press INT TRIG 1.
1.4 DC-GND-AC. Set CH1 to DC, CH2 to GND.
1.5 Turn VAR fully clockwise.
1.6 Set VOLTS/DIV to Col. 1 below.
1.7 Set Calibrator to Col. 2.
1.8 Adjust trimmer, Col. 3, for square corner.
1.9 Repeat 1.6 through 1.8 until trimmers in Col.3 have been adjusted.

VOLTS/DIV	Squarewave 1 kHz	Adjust
1	2	3
Volt	Volt	
20 m	0.1	C914
50 m	0.25	C911
0.1	0.5	C907
0.2	1	C912
0.5	2.5	C908
1	5	C904

1.10 Connect a compensated X10 probe between Calibrator and INPUT 1.
1.11 Repeat 1.6 through 1.8 with reference to table below.

VOLTS/DIV	Squarewave 1 kHz	Adjust
1	2	3
Volt	Volt	
0.1	5	C905 (0.2 V probe)
1	50	C902 (1.0 V probe)

1.12 Disconnect Calibrator and probe.

2.0 To set CH2 Attenuator compensation. PC73
2.1 Connect Calibrator to INPUT 2.
2.2 Check CH2 is on.
2.3 Press INT TRIG 2.
2.4 DC-GND-AC. Set CH1 to GND, CH2 to DC.
2.5 Carry out operation 1.5 through 1.12 above, using the respective CH2 controls.

4.3.11 **HORIZONTAL AMPLIFIER (gain & timings)**

1.0 To set sweep speed and trace length: C65, C67, C207, R106, R131, R132. PC 110A

1.1 Push ⟷ (fine) for X1 gain.
1.2 Set TIME/DIV for 1 ms.
1.3 Connect Market Generator to INPUT 1.
1.4 Set Marker Generator to 1 ms.
1.5 Switch CH1 on.
1.6 Press INT TRIG 1.
1.7 Adjust R132 for correct timing, 1 pulse/div.
1.8 Adjust R106 for 10.2 div trace length.
1.9 Set TIME/DIV for 0.1 μs.
1.10 Adjust C67 for 10.2 div.
1.11 Set Marker Generator to 100μs.
1.12 Set TIME/DIV to 1 ms.
1.13 Pull ⟷ (fine) out for X5 gain.
1.14 Adjust R131 for 2 markers/div.
1.15 Disconnect Marker Generator.
1.16 Connect Signal Generator to INPUT 1.
1.17 Push ⟷ (fine) X1 gain.
1.18 Set TIME/DIV to 0.1 μs.
1.19 Set Signal Generator to 10 MHz sinewave.
1.20 Adjust C65 for linearity of timing at the start of the trace.
1.21 Adjust C207 (TIME/DIV) switch for 1 cycle/div.

2.0 To set EXT X compensation: C2. PC110A

2.1 Connect Calibrator to EXT X socket.
2.2 Set Calibrator to approximately 700 mV peak to peak, 100 kHz squarewave.
2.3 Set VAR (sweep) to EXT X.
2.4 Pull ⟷ (fine) for X5 gain.
2.5 Observe trace equals 3.5 divs approximately.
2.6 Adjust C2 to remove over and under shoot.
2.7 Disconnect Calibrator.
2.8 Push ⟷ (fine) for X1 gain.
2.9 Turn VAR (sweep) fully clockwise.

4.3.12 **SWEEP (Single Shot adjustment)**

1.0 Set Single shot: R112. PC110A

1.1 Switch CH1 on, CH2 off.
1.2 Press INT TRIG 1.
1.3 Set DC–GND–AC to AC.
1.4 Connect Signal Generator to INPUT 1.
1.5 Set Signal Generator to 50 mV squarewave, 1-20 kHz to give 5 divisions display.
1.6 Set TIME/DIV to 1 ms.
1.7 Press AC (Trig Mode).
1.8 Adjust LEVEL for locked display.
1.9 Press SINGLE SHOT.
1.10 Turn R112 slightly anticlockwise.
1.11 Press RESET.
1.12 Observe if single sweep occurs.
1.13 Repeat 1.9 through 1.12 until single sweep fails to occur and note slot position of R112.
1.14 Set TIME/DIV to 0.1 μs.
1.15 Turn R112 slightly clockwise.
1.16 Press RESET.
1.17 Observe Neon.
1.18 Repeat 1.15 through 1.17 until single sweep fails to occur and note slot position of R112.

NOTE: The sweep and neon light should be too fast to observe, however, failure to single sweep is indicated by the neon remaining on.

1.19 Set R112 midway between positions noted in 1.13 and 1.18.
1.20 Set DC-GND-AC to GND.
1.21 Press RESET, observe neon light.
1.22 Set DC-GND-AC to AC.
1.23 Observe neon extinguishes, indicating sweep has occurred.
1.24 Disconnect Signal Generator.
1.25 Press REP.

4.3.13 **X – Y MODE (CH2 gain)**

1.0 To set X–Y gain: R787. TIME/DIV switch

1.1 Connect Calibrator to INPUT 2.
1.2 Set Calibrator to 50 mV peak to peak at 1 kHz squarewave.
1.3 Set VOLTS/DIV to 10 mV.
1.4 Push VAR (sweep) for X – Y position.
1.5 Adjust R787 for 5 div trace on X axis.
1.6 Release VAR (sweep).

4.3.14 **VERTICAL AMPLIFIER (Pulse Response)**

1.0 To set CH1 neutralization C605 and C608. PC115

1.1 Connect Calibrator to 50Ω Terminator.

NOTE: Reference 4.3.1 item 4.

1.2 Connect Terminator to INPUT 1.
1.3 Set Calibrator to 1 MHz squarewave.
1.4 Switch CH1 on, CH2 on.
1.5 Press INT TRIG 1.
1.6 DC-GND-AC. Set CH1 to DC, CH2 to GND.
1.7 Set VOLTS/DIV to 10 mV.
1.8 Set TIME/DIV to 0.2 μs.
1.9 Adjust CH1 squarewave amplitude for a 5 div trace
1.10 Adjust C605 and C608 to minimize interaction CH1 trace on CH2.

NOTE: The physical settings of C605 and C608 should approximately equal: this is determined by the relati positions of the rotor and stator vanes.

2.0 To set CH2 neutralization: C625 and C631. PC115

2.1 Connect Calibrator to 50 Ω Terminator.
2.2 Connect Terminator to INPUT 2.
2.3 Set Calibrator to 1 MHz squarewave.
2.4 Press INT TRIG 2.
2.5 DC-GND-AC. Set CH1 to GND, CH2 to DC.
2.6 Set VOLTS/DIV to 10 mV.
2.7 Set TIME/DIV to 0.2 μs.
2.8 Adjust CH2 squarewave amplitude for a 5 div trace
2.9 Adjust C625 and C631 to minimize interaction CH2 trace on CH1.

NOTE: The physical settings of C625 and C631 should approximately equal; this is determined by the relati positions of the rotor and stator vanes.

3.0 Set H.F. frequency response: C606, C619, C62 C632, R614, R681, R656, L752 & L753. PC1

CAUTION: The resultant settings of this procedure a extremely critical. Inaccuracies will have an adverse affe on bandwidth and pulse response.

3.1 Connect Calibrator to INPUT 1 via terminato Reference 4.3.1 item 4.
3.2 Set TIME/DIV to 5 μs.
3.3 Turn R614 fully clockwise.
3.4 Turn C606 until stator and rotating vanes are visib
3.5 Screw out cores of L752 and L753.
3.6 Set Calibrator to 100 kHz of 3 div amplitu approximately.
3.7 Press INT TRIG 1.
3.8 Set DC-GND-AC to DC.
3.9 Adjust LEVEL for a locked display.
3.10 Adjust C619 for corners without overshoot.
3.11 Set Calibrator to 1 MHz squarewave.
3.12 Set TIME/DIV to 0.2 μs.
3.13 Adjust R656 and C621 alternatively for optimu squarewave.

NOTE: Turn R656 clockwise until a point is reached imme iately prior to the squarewave deterioration.

3.14 Set TIME/DIV to 5 μs.
3.15 Check for flatness of wave top.
3.16 Repeat 3.12 through 3.15 until a squarewave displayed.
3.17 Set TIME/DIV to 0.2μs.
3.18 Adjust C606 for maximum overshoot.
3.19 Turn R614 slightly anticlockwise to eliminate t H.F. oscillation on the trailing edge of the fi overshoot.
3.20 Adjust C606 to eliminate overshoot.
3.21 Gradually screw in the cores of L752 and L7 alternately until the leading edge of the squarewa is vertical without overshoot.
3.22 Connect Calibrator to INPUT 2.

3.23 Press INT TRIG 2.
3.24 Adjust LEVEL for a locked display.
3.25 Turn R681 fully clockwise.
3.26 Adjust C632 for maximum overshoot.
3.27 Turn R681 slightly anticlockwise to eliminate H.F. oscillation on the trailing edge of the first overshoot.
3.28 Adjust C632 to eliminate overshoot.
3.29 Check CH1 and CH2 for similar pulse responses.
3.30 Check that the 3 dB bandwidths of both channels are better than 25 MHz at X1 gain and 15 MHz at X10.

4.3.15 CALIBRATOR

1.0 To set internal 500 mV calibrator: R416, PC112

1.1 Connect Calibrator to INPUT 1.
1.2 Set VOLTS/DIV to 100 mV.
1.3 Turn VAR fully clockwise.
1.4 Press INT TRIG 1.
1.5 Set CH1 DC-GND-AC to DC.
1.6 Set Calibrator to an accurate 500 mV peak to peak squarewave.

NOTE: The precise amplitude of display should be 5 divisions if 4.3.6 Op. 4.0 has been correctly carried out.

1.7 Connect CAL to INPUT 1.
1.8 Adjust R416 for exactly the same amplitude as found in Op. 1.6.

SECTION 5

COMPONENT LIST

All requests for repairs or replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. In the U.K. requests to be made to Harpenden.

Values of resistors are stated in ohms or multiples of ohms; ratings are in watts or sub-multiples of watts at 70°C. Values of capacitors are stated in sub-multiples of farads; ratings are in volts or kilovolts at 70°C.

Whenever possible, exact replacements for components should be used, although locally available alternatives may be satisfactory for standard components.

Any order for replacement parts should include:

1. Instrument Type.
2. Instrument Serial Number.
3. Component Circuit Reference.
4. Component Part Number.
5. Component Value.

CIRCUIT REFERENCE BLOCKS

The table below gives the blocks of circuit references, so that the reader can relate the items listed in this Section and their location in the circuitry and printed circuit boards in Chapter 6.

Circuit Reference		Circuit	Figure	P.C. Board No.
From	To			
1	60	Sweep Trigger	5	110A
61	200	Timebase X-Amp & Blanking	6	100A
201	250	Time/Div	7	116
301	400	CRT	8	110A & 112
401	600	Power supply	9	112
601	750	Y Amp Input & Channel Switching	3	115
751	900	Y Amp Output & Trigger Pre-Amp	4	119
901	999	Attenuator	2	73

ABBREVIATIONS

C	Carbon
CP	Carbon preset
CV	Carbon variable
CER	Ceramic
CT	Ceramic trimmer
CM	Cermet thick film
E	Electrolytic
Ge	Germanium
MF	Metal film
MO	Metal oxide
PE	Polyester
PE/P	Polyester paper
PP	Polypropylene
PS	Polystyrene
Se	Selenium
Si	Silicon
SM	Silver Mica
WW	Wire-wound
WWP	Wire-wound preset
WWV	Wire-wound variable

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CIR REF	PART NUMBER	VALUE V	TYPE	TOL %	RATING V	Eff Ser.No.
C2	281-0156-00	1.4-6.4 p	PP		500	
C3	285-1078-00	1.5 µ	PE	20	63	
C4	285-1078-00	1.5 µ	PE	20	63	
C5	285-0734-00	100 n	CER		30	
C6	281-0734-00	100 n	CER		30	
C7	281-0678-00	3 p	CER	0.1 p	500	
C8	281-0678-00	3 p	CER	0.1 p	500	
C9	285-0850-00	1 n	PS	5	125	
C11	285-1078-00	1.5 µ	PE	20	63	
C12	285-0940-00	12 p	PS	1	350	
C13	285-0982-00	82 p	PS	1 p	350	
C14	285-0850-00	1 n	PS	5	125	
C15	285-0854-00	100 p	PS	2	350	
C16	285-0940-00	12 p	PS	1	350	
C17	281-0710-00	10 n	CER		250	
C18	285-0786-00	33 p	PS	2	350	
C60	285-0854-00	100 p	PS	2 p	350	
C61	281-0678-00	3 p	CER	0.1 p	500	
C62	285-0854-00	100 p	PS	2 p	350	
C63	285-0867-00	20 p	PS	1 p	350	
C64	281-0710-00	10 n	CER		250	
C65	281-0154-00	2-12 p	PP		500	
C66	285-0842-00	15 p	PS	1 p	350	
C67	281-0154-00	2.12 p	PP		500	
C68	285-0776-00	27 p	PS	1 p	350	
C69	285-0915-00	100 n	PE	20	100	
C70	285-0946-00	470 n	PE	20	250	
C71	285-0869-00	47 p	PS	2 p	350	
C72	281-0734-00	100 n	CER		30	
C73	285-0873-00	200 p	PS	5	350	
C74	285-0869-00	47 p	PS	2 p	350	
C75	285-0791-00	470 n	PE	10	125	
C76	281-0734-00	100 n	CER		30	
C201	285-0869-00	47 p	PS	2 p	350	
C202	285-0844-00	39 p	PS	2 p	350	
C203	285-0769-00	10 n	PE	20	400	
C204	285-0990-00	1 µ	PE	20	160	
C205	285-0941-00	80 p	PS	1 p	350	
C206	285-1146-00	10 n	PS	1	63	656701

CIR REF	PART NUMBER	VALUE F	TYPE %	TOL	RATING V	Eff Ser N
C207	281-0732-00	3-12 p	CT		350	
C208	285-0943-00	1 µ	PC	1	63	
C209	285-0866-00	10 p	PS	1	350	
C301	285-0796-00	100 n	PE	20	250	
C302	285-0796-00	100 n	PE	20	250	
C303	285-0796-00	100 n	PE	20	250	
C304	285-0772-00	100 n	PE	10	400	
C305	285-0796-00	100 n	PE	20	250	
C306	281-0682-00	20 n	CER		2 k	

* 4KV MAY BE USED

	CIR REF	PART NUMBER	VALUE F	TYPE %	TOL	RATING V	Eff Ser N
*	C402	285-0992-00	22 n	PE/P	10	5 k	729761
	C403	285-0992-00	22 n	PE/P	10	5 k	729761
	C404	290-0540-00	15 µ	E		450	
	C405	290-0540-00	15 µ	E		450	
	C406	290-0540-00	15 µ	E		450	
	C407	290-0624-00	2.2 m	E		40	
	C408	290-0624-00	2.2 m	E		40	
	C409	290-0540-00	15 µ	E		450	
	C410	285-0992-00	22 n	PE/P	10	5 k	729761
	C411	285-0992-00	22 n	PE/P	10	5 k	729761
	C412	290-0500-00	470 µ	E		100	
	C413	290-0500-00	470 µ	E		100	
	C414	290-0624-00	2.2 m	E		40	
	C415	290-0624-00	2.2 m	E		40	
	C416	290-0624-00	2.2 m	E		40	
	C417	285-0874-00	470 p	PS	5	125	
	C418	290-0547-00	330 µ	E		160	
	C419	290-0624-00	2.2 m	E		40	
	C421	290-0547-00	330 µ	E		160	
	C422	290-0624-00	2.2 m	E		40	
	C423	290-0624-00	2.2 m	E		40	
	C424	281-0734-00	100 n	CER		30	

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING VOLTS	Eff. Ser.No.
C600	285-0796-00	100 n	PE	20	250	
C601	281-0157-00	5.5-65.5 p	PP		500	
C602	285-0845-00	68 p	PS	2 p	350	
C603	281-0723-00	1.8 p	CER	0.1 p	500	
C604	281-0156-00	1.4-6.4 p	PP		500	
C605	281-0156-00	1.4-6.4 p	PP		500	
C606	281-0157-00	5.5-65.5 p	PP		500	
C607	281-0734-00	100 n	CER		30	
C608	281-0156-00	1.4-6.4 p	CER		500	
C609	281-0723-00	1.8 p	CER	0.1 p	500	
C610	285-0791-00	470 n	PE	20	250	
C611	285-0790-00	10 n	PE	20	125	
C612	285-0788-00	100 n	PE	10	125	
C613	285-0854-00	100 p	PS	2 p	350	
C616	281-0710-00	10 n	CER		250	
C617	281-0676-00	2.2 p	CER	0.1 p	500	
C618	281-0713-00	10 p	CER	0.25 p	750	
C619	281-0155-00	2-22 p	PP		500	
C620	281-0734-00	100 n	CER		30	
C621	281-0155-00	2-22 p	PP		500	
C622	285-0854-00	100 p	PS	2 p	350	
C623	281-0734-00	100 n	CER		30	
C624	290-0494-00	47 μ	E		25	
C625	281-0156-00	1.4-6.4 p	CER		500	
C626	281-0734-00	100 n	CER		30	
C627	281-0723-00	1.8 p	CER	0.1 p	500	
C628	285-0790-00	10 n	PE	20	125	
C629	285-0788-00	100 n	PE	10	125	
C630	285-1046-00	100 n	PE	20	160	
C631	281-0156-00	1.4-6.4 p	PP		500	
C632	281-0157-00	5.5-65.5 p	PP		500	
C633	281-0723-00	1.8 p	CER	0.1 p	500	
C634	281-0156-00	1.4-6.4 p	PP		500	
C635	285-0845-00	68 p	PS	2 p	350	
C636	281-0157-00	5.5-65.5 p	PP		500	
C637	281-0710-00	10 n	CER		250	
C638	290-0493-00	22 μ	E		16	

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING VOLTS	Eff. Ser.No.
C641	285-0994-00	470 n	PE	20	100	
C642	281-0734-00	100 n	CER		30	
C751	281-0678-00	3 p	CER	0.1 p	500	
C752	285-0795-00	220 n	PE	20	250	
C753	281-0710-00	10 n	CER		250	
C754	281-0710-00	10 n	CER		250	
C755	281-0713-00	10 p	CER	0.25 p	750	
C756	281-0713-00	10 p	CER	0.25 p	750	
C757	285-0920-00	56 p	PS	2 p	350	
C758	285-0920-00	56 p	PS	2 p	350	707601
*C901	285-0772-00	100 n	PE	10	400	
*C902	281-0145-00	6-25 p	CT		500	
*C903	285-0810-00	820 p	PS	5	125	
*C904	281-0136-00	3-10 p	CT		500	
*C905	281-0145-00	6-25 p	CT		500	
*C906	285-0869-00	47 p	PS	2 p	350	
*C907	281-0136-00	3-10 p	CT		500	
*C908	281-0145-00	6-25 p	CT		500	
*C909	285-0842-00	15 p	PS	1 p	350	
*C911	281-0136-00	3-10 p	CT		500	
*C912	281-0136-00	3-10 p	CT		500	
*C913	283-0653-00	5 p	SM	10	350	
*C914	281-0145-00	6-25 p	CT		500	

*Two per instrument

CIR REF	PART NUMBER	VALUE V	DESCRIPTION	TYPE	TOL %	RATING	Eff. Ser.No.
D1	152-0062-01		1N914	Si		75 V	
D2	152-0062-01		1N914	Si		75 V	
D3	152-0370-00		AAY30	Ge			
D4	152-0062-01		1N914	Si		75 V	
D5	152-0062-01		1N914	Si		75 V	
D64	152-0062-01		1N914	Si		75 V	
D65	152-0062-01		1N914	Si		75 V	
D66	152-0062-01		1N914	Si		75 V	
D67	152-0483-00		25 pA leakage current at −6V and 25°C				
D68	152-0062-01		1N914	Si		75 V	
D69	152-0494-00	75	Zener	Si	5	700 mW	
D71	152-0062-01		1N914	Si		75 V	
D72	152-0062-01		1N914	Si		75 V	
D73	152-0062-01		1N914	Si		75 V	
D74	152-0062-01		1N914	Si		75 V	
D75	152-0062-01		1N914	Si		75 V	
D76	152-0062-01		1N914	Si		75 V	
D77	152-0062-01		1N914	Si		75 V	
D78	152-0062-01		1N914	Si		75 V	
D79	152-0062-01		1N914	Si		75 V	
D81	152-0062-01		1N914	Si		75 V	
D82	152-0062-01		1N914	Si		75 V	
D83	152-0062-01		1N914	Si		75 V	
D84	152-0468-00		BAX16	Si		150 V	
D85	152-0062-01		1N914	Si		75 V	

CIR REF	PART NUMBER	VALUE V	DESCRIPTION	TYPE	TOL %	RATING	Eff. Ser.No.
D301	152-0344-00	100	Zener	Si	10	330 mW	
D401	152-0515-00	6 k	Rectifier	Si		8 mA	
D402	152-0515-00	6 k	Rectifier	Si		8 mA	
D403	152-0341-00	450	Rectifier	Si		500 mA	
D404	152-0515-00	6 k	Rectifier	Si		8 mA	
D405	152-0515-00	6 k	Rectifier	Si		8 mA	
D406	152-0341-00	450	Rectifier	Si		500 mA	
D407	152-0339-00	50	Rectifier	Si		500 mA	
D408	152-0339-00	50	Rectifier	Si		500 mA	
D410	152-0515-00	6 k	Rectifier	Si		8 mA	
D411	152-0515-00	6 k	Rectifier	Si		8 mA	
D412	152-0339-00	50	Rectifier	Si		500 mA	
D413	152-0339-00	50	Rectifier	Si		500 mA	
D414	152-0062-01		1N914	Si		75 V	
D415	152-0062-01		1N914	Si		75 V	
D416	152-0062-01		1N914	Si		75 V	
D601	152-0554-00		BAY74	Si			
D603	152-0554-00		BAY74	Si			
D604	152-0348-00	6.2 V	Zener	Si	5	330 mW	
D605	152-0062-01		1N914	Si		75 V	
D606	152-0062-01		1N914	Si		75 V	
D607	152-0062-01		1N914	Si		75 V	
D608	152-0062-01		1N914	Si		75 V	
D609	152-0062-01		1N914	Si		75 V	
D610	152-0554-00		BAY74	Si			
D611	152-0348-00	6.2 V	Zener	Si	5	330 mV	
D612	152-0554-00		BAY74	Si			
D751	152-0062-01		1N914	Si		75V	656801
D752	152-0543-00	5.1 V	Zener	Si	5	400 mW	656801
DL751	119-0155-00	200 ns	Delay line				
F401	159-0077-00		Fuse 1.25" delay 200 – 250 V			250 mA	
	159-0079-00		Fuse 1.25" delay 100 – 125 V			500 mA	
L1	108-0665-00	4.7 μ	Fixed Inductor				
L2	108-0665-00	4.7 μ	Fixed Inductor				
L61	108-0482-00	160 μH	Fixed Inductor				
L601	108-0482-00	160 μH	Fixed Inductor				
L602	108-0482-00	160 μH	Fixed Inductor				
L603	108-0665-00		60 turns on 220 Ω				
L751	108-0662-00	100 Ω	Trace rotation coil 945 turns				
L752	114-0301-00	4.7 μH	Variable inductor				
L753	114-0301-00	4.7 μH	Variable inductor				
LP401	150-0182-00	18 V	LES			750 mW	
LP402	150-0081-00	14 V	Capless			750 mW	
LP403	150-0081-00	14 V	Capless			750 mW	

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING WATTS	Eff. Ser.No
R1	317-0104-01	100 k	C	5	125 m	
R2	317-0244-01	240 k	C	5	125 m	
R3	317-0104-01	100 k	C	5	125 m	
R4	303-0183-01	18 k	C	5	1	
R5	317-0271-01	270	C	5	125 m	
R6	317-0152-01	1.5 k	C	5	125 m	
R8	317-0222-01	2.2 k	C	5	125 m	
R9	317-0182-01	1.8 k	C	5	125 m	
R10	316-0225-01	2.2 M	C	10	250 m	
R11	317-0102-01	1	C	5	125 m	
R12	317-0332-01	3.3 k	C	5	125 m	
R13	317-0821-01	820	C	5	125 m	
R14	317-0222-01	2.2 k	C	5	125 m	
**R15	311-1836-00	2.2 k	CV	20	250 m	
R16	317-0821-01	820	C	5	125 m	
R17	311-0719-00	470	CP	20	250 m	
R18	317-0222-01	2.2 k	C	5	125 m	
R19	317-0821-01	820	C	5	125 m	
R20	317-0221-01	220	C	5	125 m	
R21	317-0332-01	3.3 k	C	5	125 m	
R22	317-0222-01	2.2 k	C	5	125 m	
R23	317-0182-01	1.8 k	C	5	125 m	
R24	317-0122-01	1.2 k	C	5	125 m	
R26	317-0153-01	15 k	C	5	125 m	
R27	317-0822-01	8.2 k	C	5	125 m	
R28	317-0393-01	39 k	C	5	125 m	
R29	317-0221-01	220	C	5	125 m	
R30	317-0682-01	6.8 k	C	5	125 m	
R31	317-0122-01	1.2 k	C	5	125 m	
R32	317-0474-01	470 k	C	5	125 m	
R33	317-0222-01	2.2 k	C	5	125 m	
R34	311-0717-00	220	CP	20	125 m	
R35	317-0471-01	470	C	5	125 m	
R36	317-0332-01	3.3 k	C	5	125 m	
R37	317-0103-01	10 k	C	5	125 m	
R38	317-0222-01	2.2 k	C	5	125 m	
R39	317-0393-01	39 k	C	5	125 m	
R40	317-0123-01	12 k	C	5	125 m	
R41	317-0182-01	1.8 k	C	5	125 m	
R42	317-0182-01	1.8 k	C	5	125 m	
R43	317-0103-01	10 k	C	5	125 m	
R44	317-0333-01	33 k	C	5	125 m	
R45	317-0104-01	100 k	C	5	125 m	
R46	317-0132-01	1.3 k	C	5	125 m	
R47	317-0183-01	18 k	C	5	125 m	
R48	317-0100-01	10	C	5	125 m	
R49	301-0273-01	27 k	CF	5	500 m	
R51	317-0272-01	2.7 k	C	5	125 m	
R60	317-0332-01	3.3 k	C	5	125 m	
R61	317-0124-01	120 k	C	5	125 m	
R62	317-0681-01	680	C	5	125 m	
R63	317-0124-01	120 k	C	5	125 m	
R64	317-0104-01	100 k	C	5	125 m	
R65	317-0104-01	100 k	C	5	125 m	
R66	317-0564-01	560 k	C	5	125 m	
R67	307-0147-00	8.2 k	MO	5	1.5	
R68	315-0152-02	1.5 k	C	5	250 m	
R69	317-0123-01	12 k	C	5	125 m	
R70	317-0123-01	12 k	C	5	125 m	
R71	307-0142-00	4.7 k	MO	5	1.5	
*R72	311-0750-00	22 k	CP	20	250 m	
R73	317-0822-01	8.2 k	C	5	125 m	
R74	317-0472-01	4.7 k	C	5	125 m	
R75	317-0103-01	10 k	C	5	125 m	
R76	317-0821-01	820	C	5	125 m	
R77	317-0103-01	10 k	C	5	125 m	
R78	307-0144-00	10 k	MO	5	1.5	
R79	317-0473-01	47 k	C	5	125 m	
R80	317-0681-01	680	C	5	125 m	
R81	317-0331-01	330	C	5	125 m	
R82	317-0680-01	68	C	5	125 m	

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING WATTS	Eff. Ser.No
R83	317-0361-01	360	C	5	125 m	
R84	317-0563-01	56 k	C	5	125 m	
R85	317-0392-01	3.9 k	C	5	125 m	
R86	317-0103-01	10 k	C	5	125 m	
R87	317-0101-01	100	C	5	125 m	
R88	317-0273-01	27 k	C	5	125 m	
R89	316-0103-01	10 k	C	10	250 m	
R90	317-0243-01	24 k	C	5	125 m	
R91	317-0154-01	150 k	C	5	125 m	
R92	317-0104-01	100 k	C	5	125 m	
R93	311-0802-00	4.7 k	CP	20	250 m	
R94	317-0272-01	2.7 k	C	5	125 m	
R95	317-0392-01	3.9 k	C	5	125 m	
R96	316-0106-01	10 M	C	10	250 m	
R97	316-0225-01	2.2 M	C	10	250 m	
R98	317-0183-01	18 k	C	5	125 m	
R99	317-0333-01	33 k	C	5	125 m	
R101	317-0223-01	22 k	C	5	125 m	
R102	317-0105-01	1 M	C	5	125 m	
R103	321-0289-48	10 k	MF	1	125 m	
R104	317-0563-01	56 k	C	5	125 m	
R105	317-0393-01	39 k	C	5	125 m	
R106	311-0750-00	22 k	CP	20	250 m	
R107	317-0223-01	22 k	C	5	125 m	
R108	317-0183-01	18 k	C	5	125 m	
R109	317-0472-01	4.7 k	C	5	125 m	
R110	317-0392-01	3.9 k	C	5	125 m	
R111	317-0332-01	3.3 k	C	5	125 m	
R112	311-0750-00	22 k	CP	20	250 m	
R113	317-0332-01	3.3 k	C	5	125 m	
R114	317-0103-01	10 k	C	5	125 m	
R115	317-0472-01	4.7 k	C	5	125 m	
R116	317-0512-01	5.1 k	C	5	125 m	
†R118	311-1209-00	5 k	CV	20	250 m	
R119		1 k	CV	20	250 m	
R120	317-0680-01	68	C	5	125 m	
R121	317-0682-01	6.8 k	C	5	125 m	
R122	321-0289-48	10 k	MF	1	125 m	
R123	315-0273-02	27 k	C	5	250 m	
R124	317-0681-01	680	C	5	125 m	
R125	308-0732-00	3.3 k	WW	5	6	
R126	317-0273-01	27 k	C	5	125 m	
R127	315-0683-01	68 k	C	5	250 m	
R128	317-0101-01	100	C	5	125 m	
R129	317-0124-01	120 k	C	5	125 m	
R130	317-0561-01	560	C	5	125 m	
R131	311-0712-00	100	CP	20	250 m	
R132	311-0913-00	1.5 k	CP	20	250 m	
R133	317-0101-01	100	C	5	125 m	
R134	317-0471-01	470	C	5	125 m	
R135	308-0732-00	3.3 k	WW	5	6	
R136	321-0114-48	150	MF	1	125 m	
R137	322-0699-48	51 k	MF	1	250 m	
R138	321-0844-48	2.2 k	MF	1	125 m	
R139	317-0331-01	330	C	5	125 m	
R140	317-0331-01	330	C	5	125 m	
R141	303-0203-01	20 k	C	5	1	
R143	321-0210-48	1.5 k	MF	1	125 m	
R144	317-0471-01	470	C	5	125 m	
R145	321-0877-48	62 k	MF	1	125 m	
R146	317-0272-01	2.7 k	C	5	125 m	
R147	317-0272-01	2.7 k	C	5	125 m	
R151	317-0272-01	2.7 k	C	5	125 m	
R152	317-0224-01	220 k	C	5	125 m	
R202	317-0242-01	2.4 k	C	5	125 m	
R203	317-0302-01	3 k	C	5	125 m	
R204	317-0392-01	3.9 k	C	5	125 m	

* Concentric pot † Dual with R119 **Dual with S63

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING WATTS	Eff. Ser.No
R205	317-0153-01	15 k	C	5	125 m	
R206	321-0351-48	44.2 k	MF	1	125 m	
R207	315-0394-02	390 k	C	5	250 m	
R208	311-1211-00	100 k	CV	20	1	
R209	324-0585-40	12.1 M	MF	1	1	
R211	324-0556-40	6.04 M	MF	1	1	
R212	324-0614-40	3.6 M	MF	1	1	
R213	322-1488-40	1.21 M	MF	1	250 m	
R214	321-0460-48	604 k	MF	1	125 m	
R215	321-0935-48	360 k	MF	1	125 m	
R216	321-0393-48	121 k	MF	1	125 m	
R217	321-0364-48	60.4 k	MF	1	125 m	
R218	321-0364-48	60.4 k	MF	1	125 m	
R301	311-0765-00	100 k	CP	20	250 m	
R302	311-0854-00	100 k	CV	20	100 m	
R303	316-0395-01	3.9 M	C	10	250 m	
*R304	311-1210-00	1 M	CV	20	2	
R305	315-0104-01	100 K	C	5	250 m	
**R306	311-1210-00	1 M	CV	20	2	
R307	316-0106-01	10 M	C	10	250 m	
R308	315-0105-02	1 M	C	5	250 m	
R309	315-0104-01	100 K	C	5	250 m	
R310	315-0222-01	2.2 k	C	5	250 m	
R311	317-0105-01	1 M	C	5	125 m	
†R401	311-1213-00	100	CV	20	1	
R402	303-0151-01	150	C	5	1	
R403	317-0472-01	4.7 k	C	5	125 m	
R404	315-0271-02	270	C	5	250 m	
R405	315-0560-01	56	C	5	250 m	
R406	315-0271-02	270	C	5	250 m	
R407	317-0222-01	2.2 k	C	5	125 m	
R408	307-0331-00	39	MO	5	1.5	
R409	315-0270-01	27	C	5	250 m	
R411	317-0183-01	18 K	C	5	125 m	
R413	307-0351-00	120	MO	5	3.25	
R414	315-0680-01	68	C	5	250 m	
R415	315-0220-02	22	C	5	250 m	
R416	311-0735-00	10 k	CP	20	250 m	
R440	315-0474-03	470 k	C	5	250 m	
R449	315-0474-03	470 k	C	5	250 m	
R601	317-0105-01	1 M	C	5	125 m	
R602A B	310-0679-00	111 k 900 k	CM	1	250 m	
R603	317-0154-01	150 k	C	5	125 m	
R604	317-0271-01	270	C	5	125 m	
R605	317-0221-01	220	C	5	125 m	
R606	317-0751-01	750	C	5	125 m	
R607	317-0472-01	4.7 k	C	5	125 m	
R608	317-0681-01	680	C	5	125 m	
R609	317-0331-01	330	C	5	125 m	

*Dual with R306 **Dual with R304 †with R761 and S402

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING WATTS	Eff. Ser.No
R610	317-0221-01	220	C	5	125 m	
R611	317-0561-01	560	C	5	125 m	
R612	317-0103-01	10 k	C	5	125 m	
R613	317-0911-01	910	C	5	125 m	
R614	311-0717-00	220	CP	20	250 m	
R615	317-0472-01	4.7 k	C	5	125 m	
R616	317-0681-01	680	C	5	125 m	
R617	311-0719-00	470	CP	20	250 m	
R618	311-0712-00	100	CP	20	250 m	
R619	317-0561-01	560	C	5	125 m	
R620	317-0331-01	330	C	5	125 m	
R621	317-0103-01	10 k	C	5	125 m	
R622	311-0717-00	220	CP	20	250 m	
R623	317-0911-00	910	C	5	125 m	
*R624	311-1212-00	500	CV	−0 +40	125 m	
R625	311-0712-00	100	CP	20	250 m	
R626	317-0271-01	270	C	5	125 m	
R627	317-0221-01	220	C	5	125 m	
R628	317-0271-01	270	C	5	125 m	
R629	317-0751-01	750	C	5	125 m	
R630	317-0681-01	680	C	5	125 m	
R631	317-0820-01	82	C	5	125 m	
R632	317-0391-01	390	C	5	125 m	
R633	315-0821-01	820	C	5	250 m	
R634	317-0473-01	47 k	C	5	125 m	
R635	317-0684-01	680 k	C	5	125 m	
R636	317-0105-01	1 M	C	5	125 m	
R637	303-0183-01	18 k	C	5	1	
R638	303-0183-01	18 k	C	5	1	
R639	317-0104-01	100 k	C	5	125 m	
R640	317-0392-01	3.9 k	C	5	125 m	
R641	317-0561-01	560	C	5	125 m	
R642	311-0717-00	220	CP	20	250 m	
R643	321-0097-48	100	MF	1	125 m	
R644	317-0471-01	470	C	5	125 m	
R645	317-0242-01	2.4 k	C	5	125 m	
R646	317-0102-01	1 k	C	5	125 m	
R647	317-0223-01	22 k	C	5	125 m	
R648	317-0103-01	10 k	C	5	125 m	
R649	317-0104-01	100 k	C	5	125 m	
R650	317-0471-01	470	C	5	125 m	
R651	317-0122-01	1.2 k	C	5	125 m	
R652	311-1028-00	100 k	CV	20	250 m	
R653	317-0152-01	1.5 k	C	5	125 m	
R654	317-0223-01	22 k	C	5	125 m	
R655	317-0103-01	10 k	C	5	125 m	
R656	311-0735-00	10 k	CP	20	250 m	
R657	317-0221-01	220	C	5	125 m	
R658	317-0471-01	470	C	5	125 m	
R659	321-0097-48	100	MF	1	125 m	
R660	317-0221-01	220	C	5	125 m	
R661	317-0471-01	470	C	5	125 m	
R662	317-0102-01	1 k	C	5	125 m	
R663	317-0223-01	22 k	C	5	125 m	
R664	317-0103-01	10 k	C	5	125 m	
R665	317-0180-01	18	C	5	125 m	
R666	317-0821-01	820	C	5	125 m	
R667	317-0221-01	220	C	5	125 m	
R668	317-0393-01	39 k	C	5	125 m	
R669	311-0717-00	220	CP	20	250 m	
R670	317-0122-01	1.2 k	C	5	125 m	
R671	317-0393-01	39 k	C	5	125 m	
R672	311-1306-00	100 k	CV	20	250 m	
R673	315-0470-01	47	C	5	250 m	
R674	317-0433-01	43 k	C	5	125 m	
R675	317-0105-01	1 M	C	5	125 m	
R676	317-0564-01	560 k	C	5	125 m	
R677	317-0221-01	220	C	5	125 m	
R678	317-0271-01	270	C	5	125 m	
R679	317-0820-01	82	C	5	125 m	
R680	317-0101-01	100	C	5	125 m	
R681	311-0717-00	220	CP	20	250 m	
R682	317-0472-01	4.7 k	C	5	125 m	
R683	317-0681-01	680	C	5	125 m	
R684	317-0561-01	560	C	5	125 m	
R685	317-0103-01	10 k	C	5	125 m	
R686	317-0911-01	910	C	5	125 m	

*Log inverse pot

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING WATTS	Eff. Ser.No.
R687	317-0751-01	750	C	5	125 m	
R688	317-0472-01	4.7 k	C	5	125 m	
R689	317-0681-01	680	C	5	125 m	
R690	317-0331-01	330	C	5	125 m	
R691	311-0719-00	470	CP	20	250 m	
R692	317-0331-01	330	C	5	125 m	
R693	311-0712-00	100	CP	20	250 m	
R694	317-0561-01	560	C	5	125 m	
R695	317-0103-01	10 k	C	5	125 m	
R696	317-0123-01	12 k	C	5	125 m	
R697	311-0717-00	220	CP	20	250 m	
R698	317-0911-01	910	C	5	125 m	
R699	311-1212-00	500	CV	−0 +40	125 m	
R700	317-0101-01	100	C	5	125 m	
R701	311-0712-00	100	CP	20	250 m	
R702	317-0751-00	750	C	5	125 m	
R703	317-0271-01	270	C	5	125 m	
R704	317-0221-01	220	C	5	125 m	
R705	317-0271-01	270	C	5	125 m	
R706	317-0154-01	150 k	C	5	125 m	
R707A B	310-0679-00	111 k 900 k	CM	1	250 m	
R708	317-0105-00	1 M	C	5	125 m	
R709	317-0180-01	18	C	5	125 m	
R710	307-0427-00	2.2 R	CF	5	125 m	656201
R751	317-0471-01	470	C	5	125 m	
R752	321-0100-48	107	MF	1	125 m	
R753	321-0100-48	107	MF	1	125 m	
R754	315-0122-02	1.2 k	C	5	250 m	
R755	307-0326-00	1.2 k	MO	5	1.5	
R756	315-0122-02	1.2 k	C	5	250 m	656801
R759	317-0471-01	470	C	5	125 m	
*R761	311-1213-00	250	CV	20	1	
R762	307-0284-00	540	MO	5	3.5	
R763	321-1296-48	12 k	MF	1	125 m	
R764	321-0874-48	39 k	MF	1	125 m	
R765	307-0257-00	940	MO	5	1.5	
R766	317-0470-01	47	C	5	125 m	
R767	317-0470-01	47	C	5	125 m	
R768	307-0257-00	940	MO	5	1.5	
R769	317-0103-01	10 k	C	5	125 m	
R770	317-0101-01	100	CF	5	125 m	707601
R771	317-0683-01	68 k	C	5	125 m	
R772	317-0683-01	68 k	C	5	125 m	
R773	317-0333-01	33 k	C	5	125 m	
R774	317-0333-01	33 k	C	5	125 m	
R775	317-0271-01	270	C	5	125 m	
R776	317-0152-01	1.5 k	C	5	125 m	
R777	317-0331-01	330	C	5	125 m	
R778	317-0122-01	1.2 k	C	5	125 m	
R779	303-0103-01	10 k	C	5	1	
R781	307-0232-00	12 k	MO	5	1 W 5	656101
R782	317-0271-01	270	C	5	125 m	
R783	317-0152-01	1.5 k	C	5	125 m	
R784	317-0331-01	330	C	5	125 m	
R785	317-0122-01	1.2 k	C	5	125 m	
R786	317-0222-01	2.2 k	C	5	125 m	
R787	311-1091-00	6.8 k	CP	20	250 m	
**R901	321-1289-43	10.1 k	MF	0.25	125 m	
**R902	321-0989-43	990 k	MF	0.25	125 m	
**R903	321-1389-43	111 k	MF	0.25	125 m	
**R904	321-0988-43	900 k	MF	0.25	125 m	
**R905A	310-0680-00	250 k	CM	1	250 m	
**R905B		800 k				
** C		1 M				
** D		500 k				
**R909	315-0470-01	47	C	5	250 m	

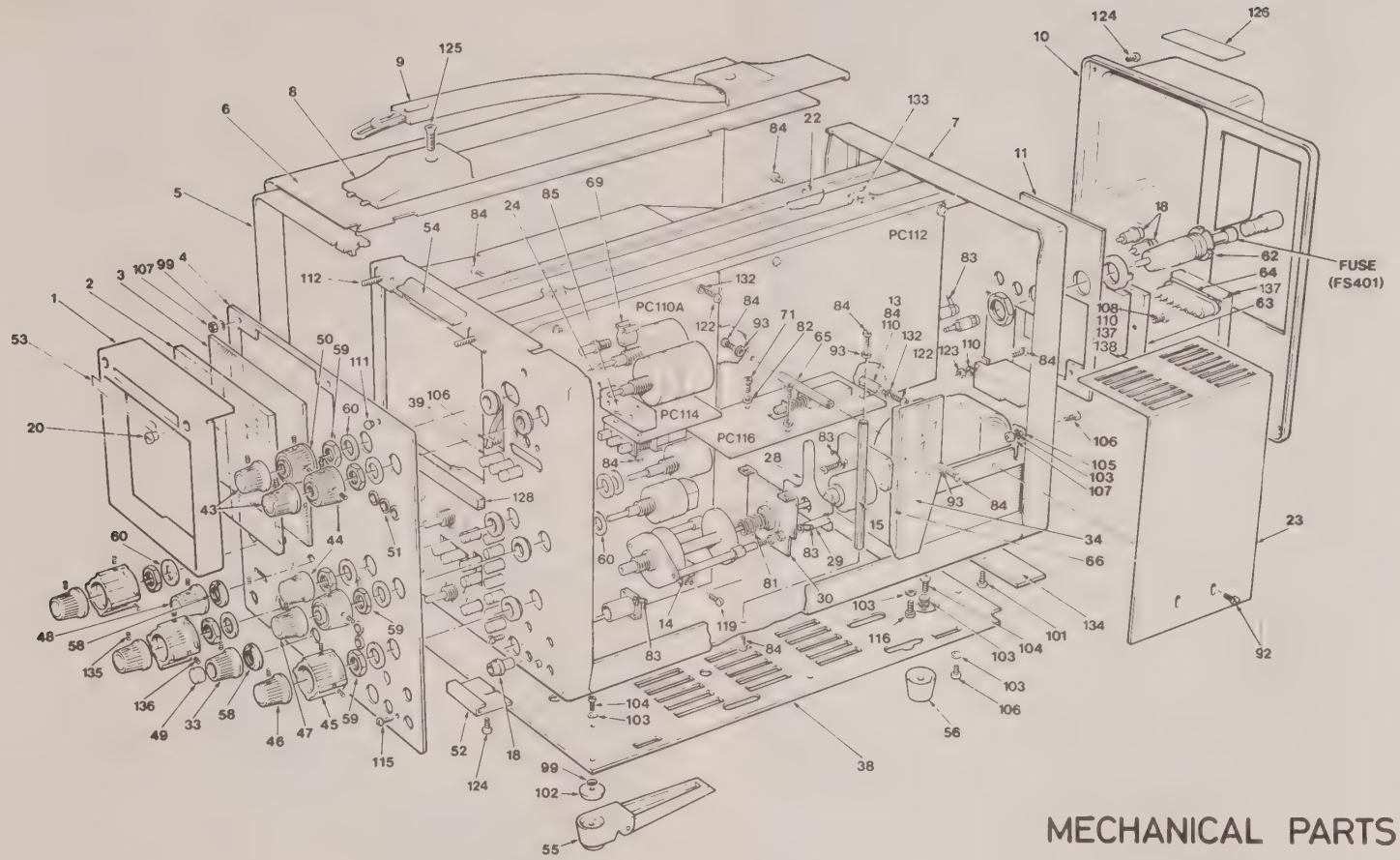
CIR REF	PART NUMBER	DESCRIPTION
S1a		
S1b		
S1c		
S1d	260-1799-00	Push (7 — button)
S1e		
S2		
S3		
S61	311-1211-00	Rotary (with R208)
S62	260-1295-00	Push (3 — button)
S63		Rotary (with R15)
S66	260-1106-02	Push (1 — button)
S67	311-1209-00	Pull (with R118 and R119)
S201	260-1798-01	Rotary (23 — position) 656201
S402	311-1213-00	Rotary with R401 and R761
S601	260-1299-00	Push (1 — button)
S602	260-1299-00	Push (1 — button)
S603	260-1204-00	Push (2 — button)
S604	260-1298-00	Push (1 — button)
S605	260-1298-00	Push (1 — button)
S606	260-1298-00	Push (1 — button)
S751	260-1089-00	Push (2 — button)
**S901	260-1307-01	Slide (3 — position) for Front Panel Slot 14 mm by 14.8 mm
**S902	260-1051-01	Rotary (12 — position)
SK1	131-0651-00	BNC Connector EXT X
SK601	131-0651-00	BNC Connector CHI INPUT
SK701	131-0651-00	BNC Connector CH2 INPUT
T401	120-0731-01	Power transformer

*with R401 and S402 **Two per instrument

CIR REF	PART NUMBER	DESCRIPTION	MATERIAL	TYPE	Eff. Ser.No.
TR1	151-0317-00	BC 109C	Si	NPN	
TR2	151-0242-00	2N3904	Si	NPN	
TR3	151-0242-00	2N3904	Si	NPN	
TR4	151-0242-00	2N3904	Si	NPN	
TR5	151-0242-00	2N3904	Si	NPN	
TR6	151-0317-00	BC109C	Si	NPN	
TR62	151-0317-00	BC 109C	Si	NPN	
TR64	151-0257-00	2N199OU	Si	NPN	
TR65	151-0257-00	2N199OU	Si	NPN	
TR66	151-0317-00	BC 109C	Si	NPN	
TR67	151-0257-00	2N199OU	Si	NPN	
TR68	151-0317-00	BC 109C	Si	NPN	
TR69	151-0317-00	BC 109C	Si	NPN	
TR71	151-1052-00	FET BFW1052	Si	N-Channel	
TR72	151-0317-00	BC 109C	Si	NPN	
TR73	151-0317-00	BC 109C	Si	NPN	
TR74	151-0317-00	BC 109C	Si	NPN	
TR75	151-0127-03	BSX20	Si	NPN	
TR76	151-0317-00	BC 109C	Si	NPN	
TR77	151-0257-00	2N199OU	Si	NPN	
TR78	151-0317-00	BC 109C	Si	NPN	
TR79	151-0317-00	BC 109C	Si	NPN	
TR81	151-0257-00	2N199OU	Si	NPN	
TR82	151-0490-00	FRB750			656201
TR601	151-1036-00	FET, TEK.	Si	N-Channel	
TR602					
TR603	151-0127-02	BSX20/2N2369	Si	NPN	
TR604	151-0127-02	BSX20/2N2369	Si	NPN	
TR605	151-0242-00	2N3904	Si	NPN	
TR606	151-0242-00	2N3904	Si	NPN	
TR607	151-0127-02	BSX20/2N2369	Si	NPN	
TR608	151-0127-02	BSX20/2N2369	Si	NPN	
TR609	151-0127-02	BSX20/2N2369	Si	NPN	
TR611	151-0127-02	BSX20/2N2369	Si	NPN	
TR612	151-0127-03	BSX20	Si	NPN	
TR613	151-0127-03	BSX20	Si	NPN	
TR614	151-0242-00	2N3904	Si	NPN	
TR615	151-0242-00	2N3904	Si	NPN	
TR616	151-0490-00	FRB750	Si	NPN	
TR617	151-1036-00	FET, TEK.		N-Channel	
TR618					
TR619	151-0127-02	BSX20/2N2369	Si	NPN	
TR621	151-0127-02	BSX20/2N2369	Si	NPN	
TR622	151-0242-00	2N3904	Si	NPN	
TR623	151-0242-00	2N3904	Si	NPN	
TR624	151-0127-02	BSX20/2N2369	Si	NPN	
TR625	151-0127-02	BSX20/2N2369	Si	NPN	
TR626	151-0127-02	BSX20/2N2369	Si	NPN	
TR627	151-0127-02	BSX20/2N2369	Si	NPN	
TR628	151-0127-02	BSX20/2N2369	Si	NPN	
TR629	151-0127-02	BSX20/2N2369	Si	NPN	
TR751	151-0127-02	BSX20/2N2369	Si	NPN	
TR752	151-0310-00	E1530	Si	NPN	
TR753	151-0310-00	E1530	Si	NPN	
TR754	151-0320-01	MPS6518 Motorola	Si	PNP	
TR755	151-0320-01	MPS6518 Motorola	Si	PNP	
TR756	151-0320-01	MPS6518 Motorola	Si	PNP	
TR757	151-0320-01	MPS6518 Motorola	Si	PNP	
V61	150-0069-00	Neon Capless 3L			
V301	154-0653-00	CRT		D14-200	

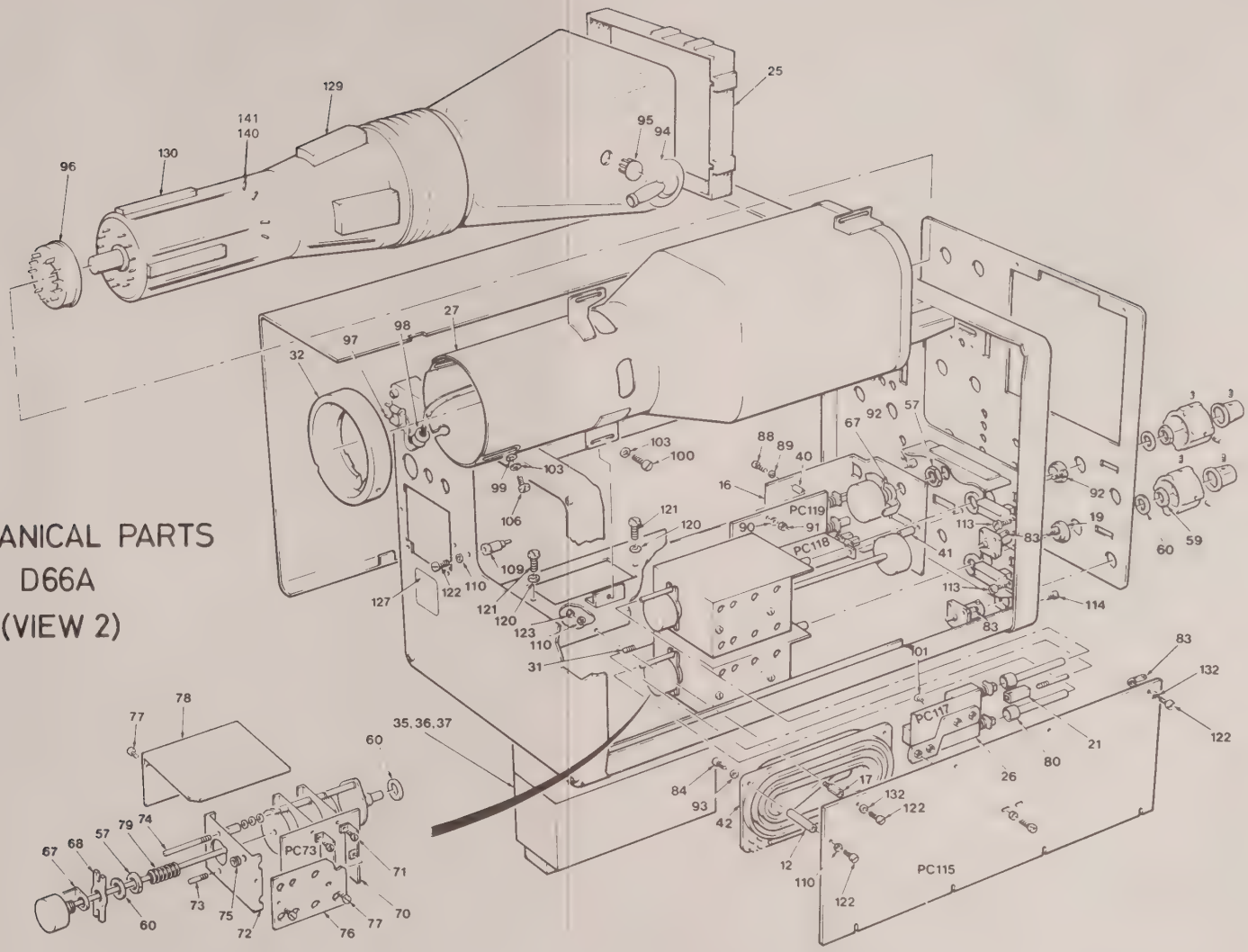
MECHANICAL PARTS LIST

Item	Description	Part No.
1	Light Hood Bezel	200-1884-00
2	Graticule	331-0232-04
3	Grey Filter (Standard)	378-0605-05
4	Front Panel	333-2254-00
5	Front Trim	124-0317-01
6	Cabinet Side LH	390-0448-06
	Cabinet Side RH	390-0448-07
7	Chassis Spotwelded	441-1356-01
8	Handle Holder	352-0434-00
9	Handle (Black)	367-0101-01
10	Rear Cover	200-1766-01
11	Rear Panel	333-2143-01
12	Spacer 6BA1" LG	361-0202-00
13	Spacer 6BA 27/32"	385-0202-00
14	Spacer 6BA 25/32"	385-0201-00
15	Spacer 6BA 82MM	385-0213-00
16	Mounting Bracket	407-0599-01
17	Spacer 6BA	361-0283-00
18	Socket 4mm Assembly	136-0381-02
19	Spacer	361-0324-01
20	Nut (Special Black)	220-0607-01
21	Switch Extension Moulding	376-0132-00
22	Securing Bar	381-0326-00
23	Voltage Warning Cover	200-1230-00
24	Switch Mounting Block	391-0094-00
25	CRT Shockmount Ring	354-0407-00
26	Mounting Bracket	407-0965-01
27	Mu-Metal Screen	337-1493-00
28	Bearing Plate	401-0143-00
29	Bearing Rod	384-0812-00
30	Switch Bracket	407-0966-01
31	Extension Rod	384-1103-00
32	CRT Ring Moulding	354-0420-00
33	Knob Assembly (CH2 - POS)	366-1365-01
34	Clamping Plate	343-0345-01
35	EHT Unit Assembly	670-1979-00
36	EHT Box, Tapped	202-0193-02
37	PC114 Wired Assembly	670-1978-00
38	Baseplate Cover	200-1235-02
39	Knob, Pushbutton, 13mm assembly	366-1414-15
40	Round Spacer 10mm	361-0537-02
41	Round Spacer 11mm	361-0537-01
42	Delay Line Assembly	119-0155-00
43	Knob Assembly (Orange)	366-1717-00
44	Knob Assembly (White)	366-1636-02
45	Knob Assembly Series 5 Recess	366-1642-00
46	Knob Assembly VAR	366-1641-00
47	Knob Assembly FINE	366-1718-00
48	Knob Assembly Med Skirted Black	366-1636-00
49	Knob Push	366-1634-00
50	Knob Assembly	366-1353-01
51	Pushbutton Bezel	200-1885-00
52	Trim Retainer	343-0591-00
53	Identification Plate	334-2611-01
54	Graticule Lamp Assembly	670-0997-00
55	Front Foot Raising Member	348-0463-00
56	Fixed Rear Foot (Black)	348-0462-00
57	Nut 3/8" x 32 TPI, 1/2" AF	220-0750-00
58	Slotted Ring Nut Chrome	220-0527-00
59	Nut Brass 3/8" x 32 TPI Chrome	220-0684-00
60	Washer 3/8" ID Plain Cad	210-3051-00
61	Plug, Belling & Lee R4091/1	134-0135-00
62	Fuse Holder, Belling & Lee	352-0499-00
63	Voltage Selection Socket	136-0315-00
64	Voltage Selection 7 pin Plug	134-0102-00
65	6BA HEX Spacer 46mm	385-0214-00
66	Rubber Strip 5/16" x 3/4" x 3 3/4 O/L	252-0632-00
67	Solder Lug 3/8" ID	210-0275-00
68	Bearing Moulding	401-0145-00
69	Lampholder Q3526	136-0311-00
70	Screen Trimmer	337-1133-00
71	Screw 2PK x 1/4" Poz Pan Cad	213-0354-00
72	Attenuator Screen	386-2042-00
73	Rod Bearing 1/2" Lg	384-0813-00
74	Bearing Rod 1 3/8" Lg	384-0814-00
75	Grommet 1/4" ID	348-0161-00
76	Front Plate screened	337-1135-00
77	Screw 4PK/AB x 3/16" Poz Pan Cad	213-0363-00
78	Screen Cover	337-1132-02
79	Compression Spring	214-1626-00
80	Sleeve Bearing 46mm LG	401-0144-00
81	Compression Spring	214-0144-01
82	Washer 8BA Large Plain	210-1211-00
83	Solder Lug 6BA	210-0297-00
84	Screw 6BA x 1/4" Poz Pan	213-0393-00
85	Neon Lamp Capless 3L	150-0069-00
86	Screw 6BA 1/4" Button Head	213-0723-00
87	Screw 4PK/AB x 5/8" Poz Pan	213-0724-00
88	Screw 8BA x 3/4" CH Slot	213-0461-00
89	Washer 8BA Shakeproof Int	210-1214-00
90	Washer 8BA Small Plain	210-1213-00
91	Nut 8BA Full Hex	220-0718-00
92	Screw 4PK/AB x 1/4" Poz Pan	213-0366-00
93	Washer 6BA Large Plain	210-1207-00
94	EHT Cap Type BRS18	200-2106-00
95	PDA Connector Button	134-0157-00
96	Tube Base 12 Pin	136-0302-00
97	Trace Rotation plug	134-0100-00
98	Grommet 3/8" ID	348-0160-00
99	Washer 4BA Large Plain Cad	210-1204-00
100	Screw 4BA x 3/16" Poz Pan Cad	213-0474-00
101	Screw 6BA x 1/4"	213-0391-00
102	Packing Washer (Foot)	210-1075-00
103	Washer 4BA Shakeproof	210-1215-00
104	Screw 4BA x 3/8" Poz Pan	213-0398-00
105	Solder Lug 4BA	210-0297-01
106	Screw 4BA x 1/4" Poz Pan	213-0388-00
107	Nut 4BA full HEX	220-0714-00
108	Screw 2 M2 x 4mm Poz Pan Chrome	213-0802-00
109	Stand Off Insulator	214-1070-00
110	Washer 6BA Shakeproof Int	210-1210-00
111	Lens Filter (Green)	378-0597-00
112	Screw 4BA x 3/4" CSK Poz	213-0472-00
113	Screw 8BA x 1/8" CH slot	213-0448-00
114	Screw 8BA x 3/16" CH Slot	213-0458-00
115	Screw 8BA x 3/8" Round Slot Chrome	213-0719-00
116	Screw 4BA x 1/4" Hex slot	213-0470-00
117	Washer 6BA Small Plain	210-1209-00
118	Washer 6BA Paxolin 1/32 thk	210-1159-00
119	Screw 6BA x 1/4" CH Nylon	213-0280-00
120	Washer 2BA Shakeproof Int	210-1203-00
121	Screw 2BA x 5/16" HEX Slot Cad	213-0484-00
122	Screw 6BA x 3/16"	213-0392-00
123	Nut 6BA Full HEX Cad	220-0716-00
124	Screw 6BA x 5/16" Poz Pan Chrome	213-0648-00
125	Screw 2BA x 5/8" INST Poz Chrome	213-0521-00
126	Marker Ident (Warning)	334-2968-00
127	Mod Record Label	334-2752-00
128	Foam Strip 1/4" x 1/4" Tesa Moll 7771/4775	252-0608-00
129	Neoprene Self Adhes. 25mm x 9mm thick	252-0628-00
130	Neoprene self adhes. 7mm x 7mm thick	252-0629-00
131	Presspahn strip 1" wide x 3" lg	253-0111-00
132	6BA Locking Washer	210-1205-00
133	Captive Nut	220-0801-00
134	Chassis Bar	381-0367-00
135	Set Screws (Knobs) M3 x 3	213-0248-00
136	Set Screws (Knobs) M3 x 5	213-0249-00
137	Cover	386-3942-00
138	Spacer 6BA	129-0607-00
139	Washer M2 plain	210-1290-00
140	Connector Female	131-0472-01
141	Sleeve Elect H12 Blue	166-0497-00



MECHANICAL PARTS
D66A
(VIEW 1)

MECHANICAL PARTS
D66A
(VIEW 2)



SECTION 6

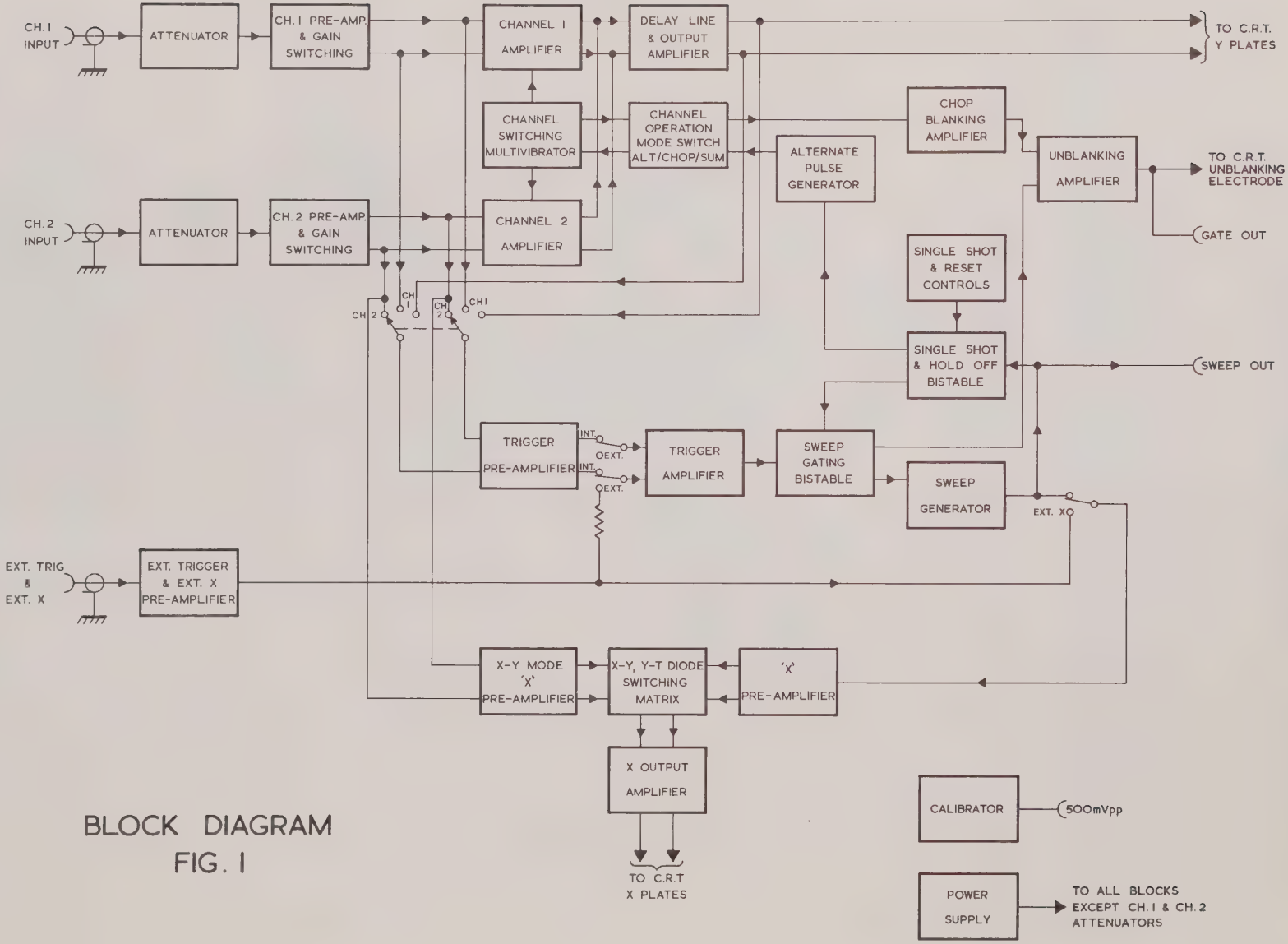
CIRCUIT DIAGRAMS

To minimize the risk of misinterpretation of component values on circuit diagrams, the decimal point has been replaced by the multiplier or sub-multiplier of the basic unit. For instance, 2.2 megohms is shown as 2M2 and 1.8 picofarads is shown as 1p8.

To aid the reader further, in addition to the block Circuit Reference Table in Section 5.1, to locate a component in the circuit diagrams, a table is provided at the top of each circuit diagram, in which the circuit reference will appear, where practicable, directly above the component being sought.

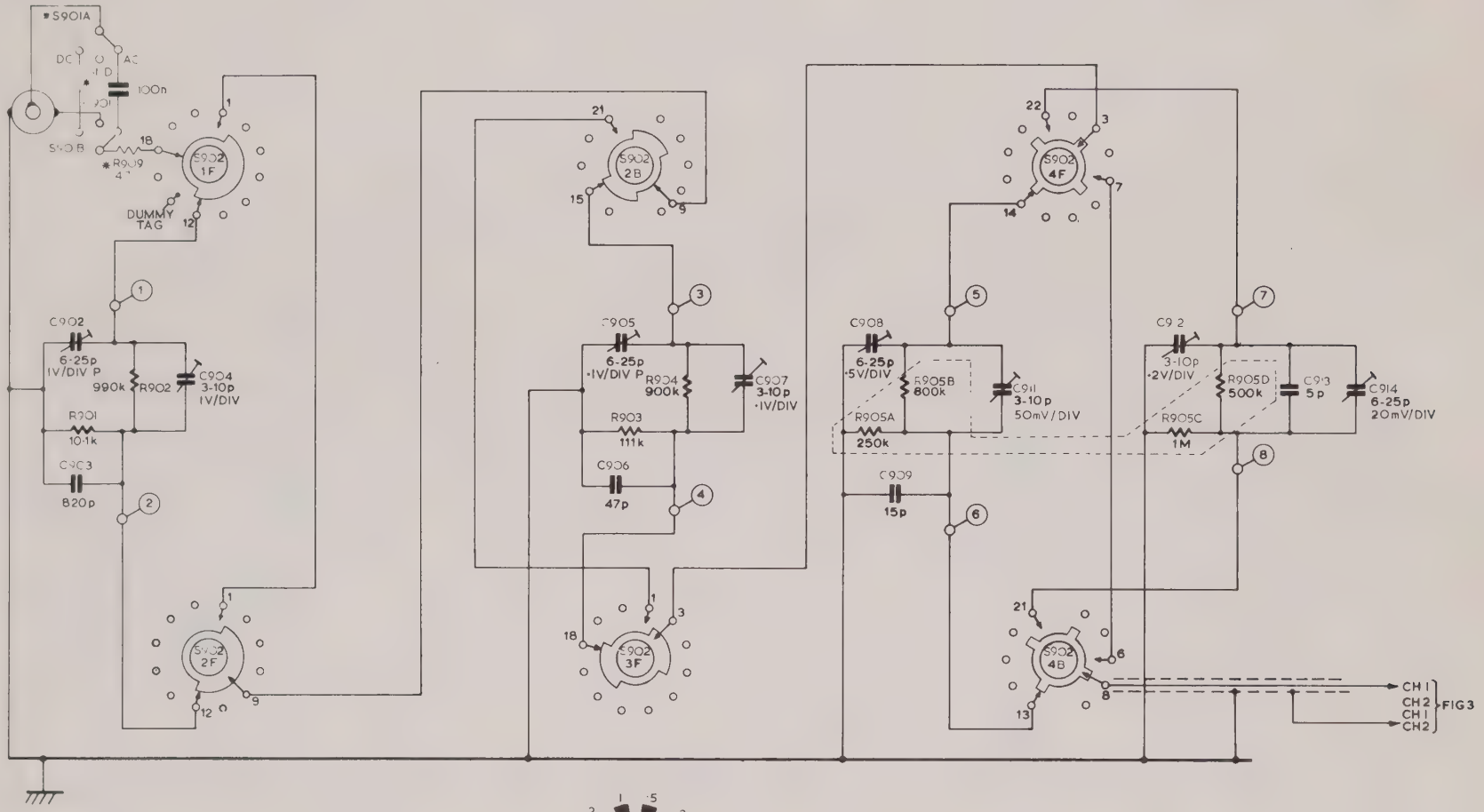
PRINTED CIRCUIT

Blue shows the rear track as seen through the board. Red, the component side track, and those components referred to in Section 4.



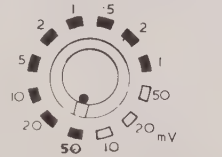
BLOCK DIAGRAM
FIG. 1

MISC	S90	S902	S902	S902
C	901 902 903 904	905 906 907	908 911 909	912 913 914
R	901 909 902	903 904	905A 905B	905C 905D



NOTES-

1. (No) DENOTES TAG NOS. ON PC.73
2. SWITCHES SHOWN IN FULLY ANTI-CLOCKWISE POSITION
3. * DENOTES COMPONENTS NOT MOUNTED ON PC. 73
4. 76/1 DENOTES PC76/EYELET No 1.



S902 (VOLTS/DIV) SWITCH POSITIONS

ATTENUATOR CIRCUIT D66A FIG. 2

RESISTORS

603 601 665 605 604 602A 608 613 606 607 617 618 611 612 602B 614 620 622 624 625 626 640 615 616 609 623 637 628 627 619 632 630 633 643 696 680 644 645 641 634 636 639 650 631 635 646 647 642 610 660 648 652 653 654 655 664 657 651 656 663 662 666 670 667 673 679 669 672 671 661 668 700 649 658 677 676 686 687 674 675 659 678 682 683 684 685 692 690 697 699 701 703 681 688 693 694 695 689 698 702 707B 704 705 707A 706 708 709 711 710

CAPACITORS

603 604 601 602 630 605 607 638 606 600 608 609 612 611 613 637 620 616 641 621 623 622 617 618 619 628 627 625 632 624 631 626 629 635 633 634 636 610

MISC

S66 S602 D601 S601 TR609 TR607 TR605 TR603 TR601 SK601 S603b S603a TR628 TR611 D603 TR608 TR606 TR604 D604 TR602 TR612 L601 S601 S602 S603a S603b L603 S601 TR614 D605 S602 D606 S603b TR616 S66 S603a D609 D607 TR615 S602 D611 D608 S605 L602 TR617 S606 S601 TR626 D610 TR625 TR622 TR619 S603b TR613 S606 S603a S604 TR629 TR627 D612 TR624 TR623 TR621 TR618 SK701

HT FOR X-Y PRE-AMP

TO FIG.4

C610 47On

C630 100n

+115V

C609 100n

TO DELAY LINE FIG.4

TO DELAY LINE FIG.4

GENERAL SEQUENCE FOR SWITCH PIN Nos SWITCH VIEWED FROM COPPER SIDE OF BOARD

SWITCH	FUNCTION
S601	CH.SEL.1
S602	CH.SEL.2
S603a	ALT (SUM)
S603b	CHOP (SUM)
S604	NORM/INVERT
S605 S606	X_1–X_{10}

CH1

CH2

TO FIG.4 PC 119/22

TO FIG.4 119/21

TO FIG.4 PC 119/19

TO PC119/20 FIG.4

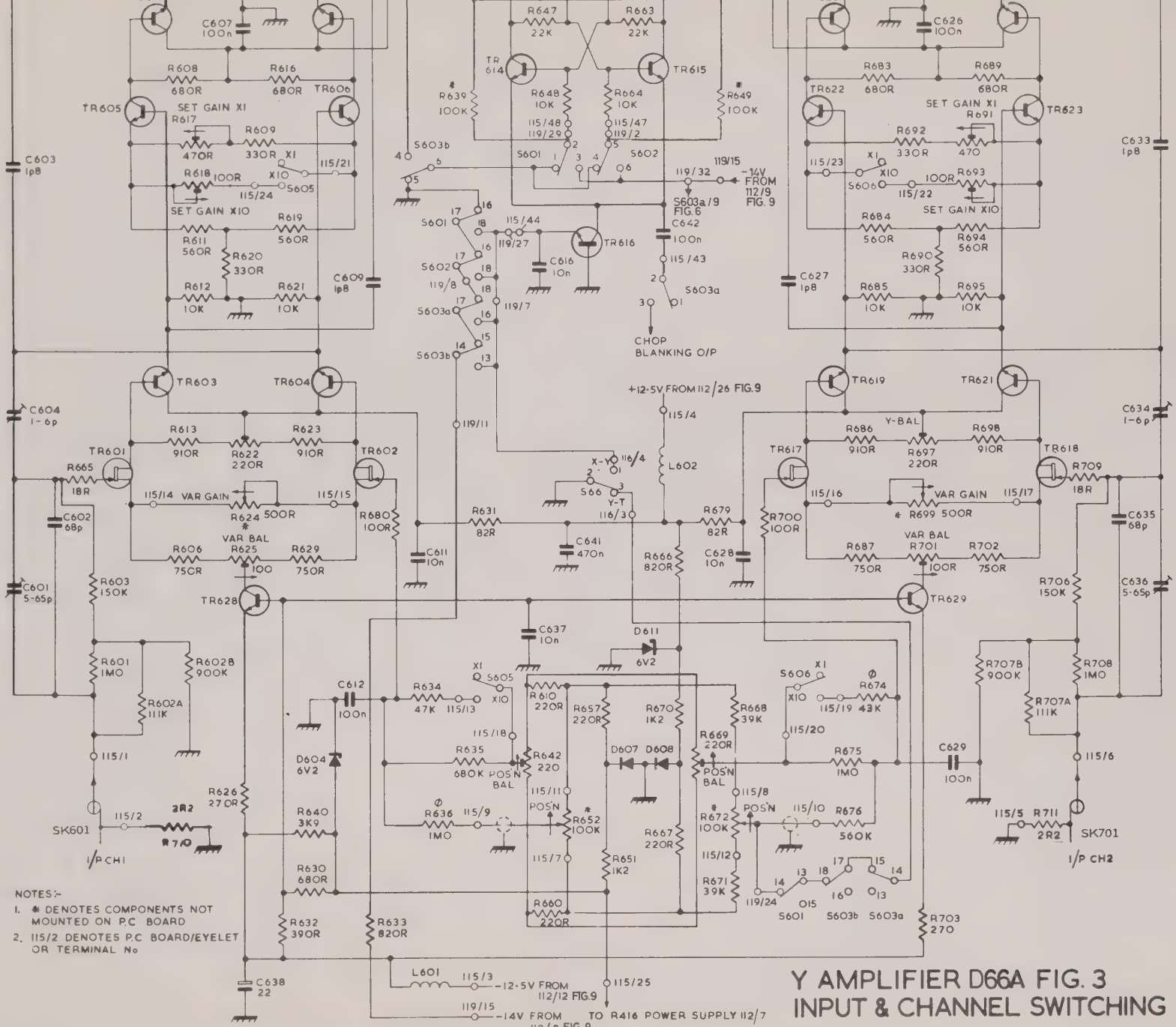
TO D82 R129 T/B 116/8 FIG. 6

FROM R114 T/B 110A/11 FIG. 6

FROM 110A/14 TR75 T/B COLLECTOR FIG. 6

NORM

INV



NOTES:-

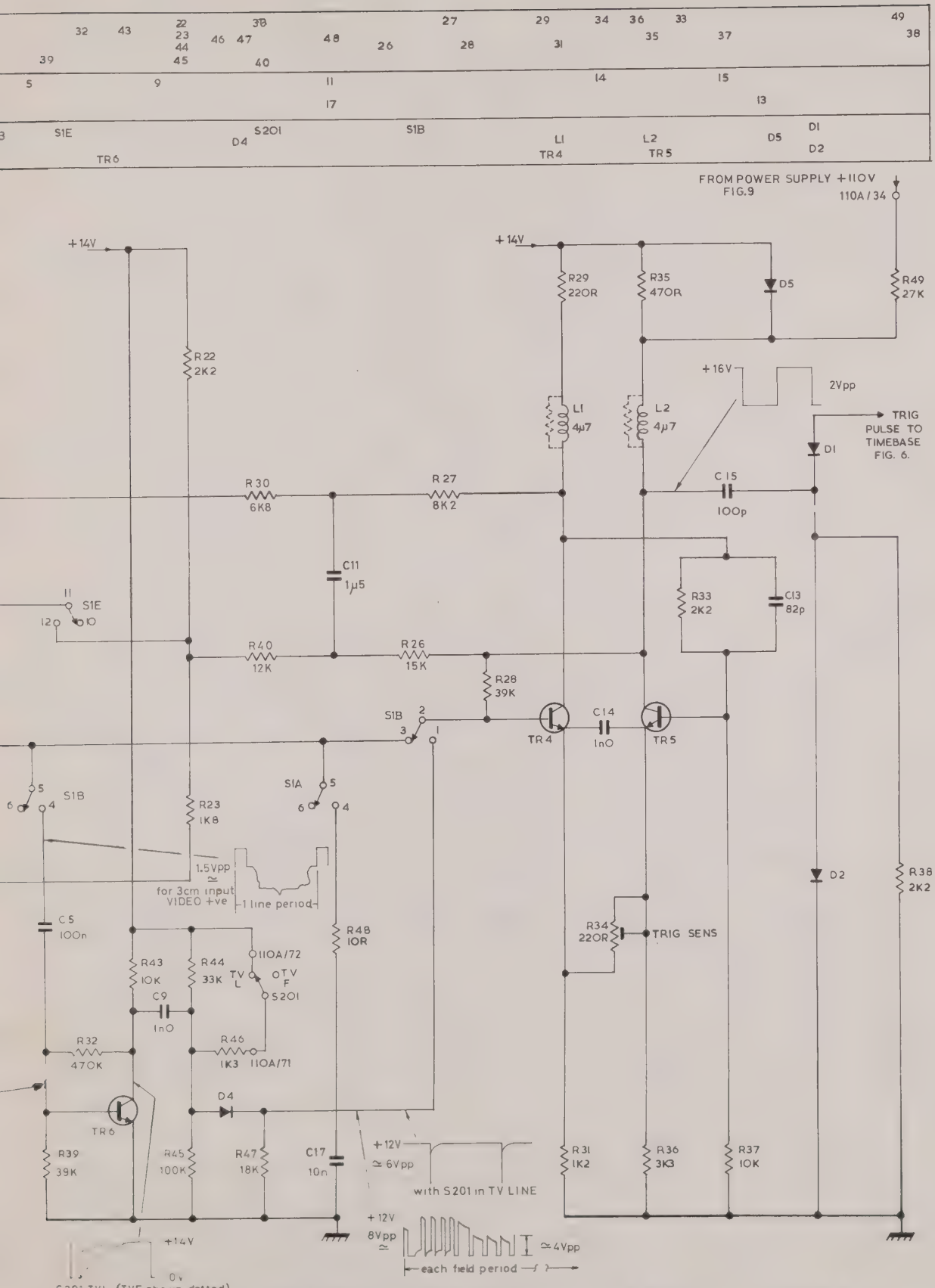
1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD
2. 115/2 DENOTES P.C. BOARD/EYELET OR TERMINAL No

Y AMPLIFIER D66A FIG. 3
INPUT & CHANNEL SWITCHING

| | | |

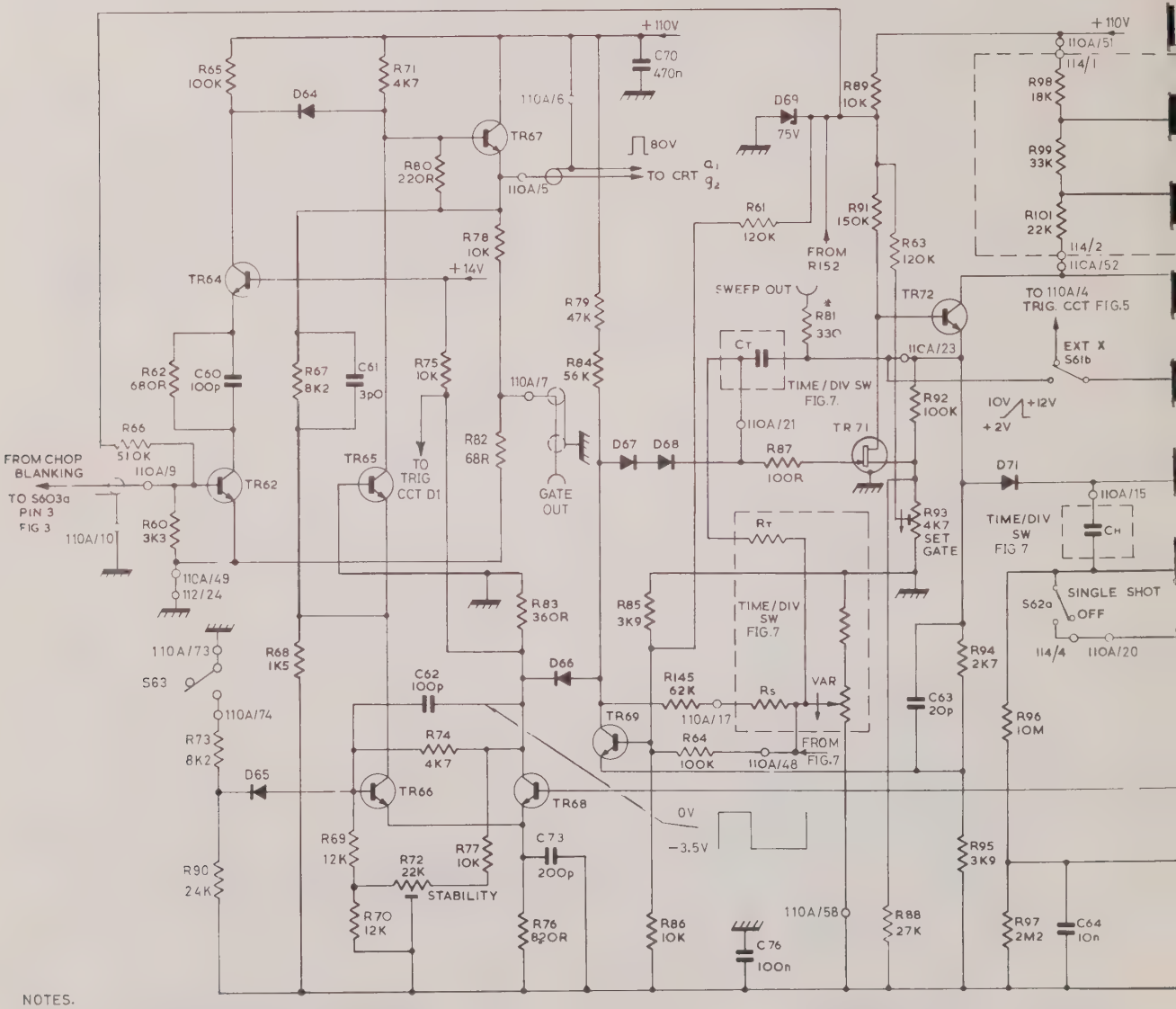
| | | |

| | | |



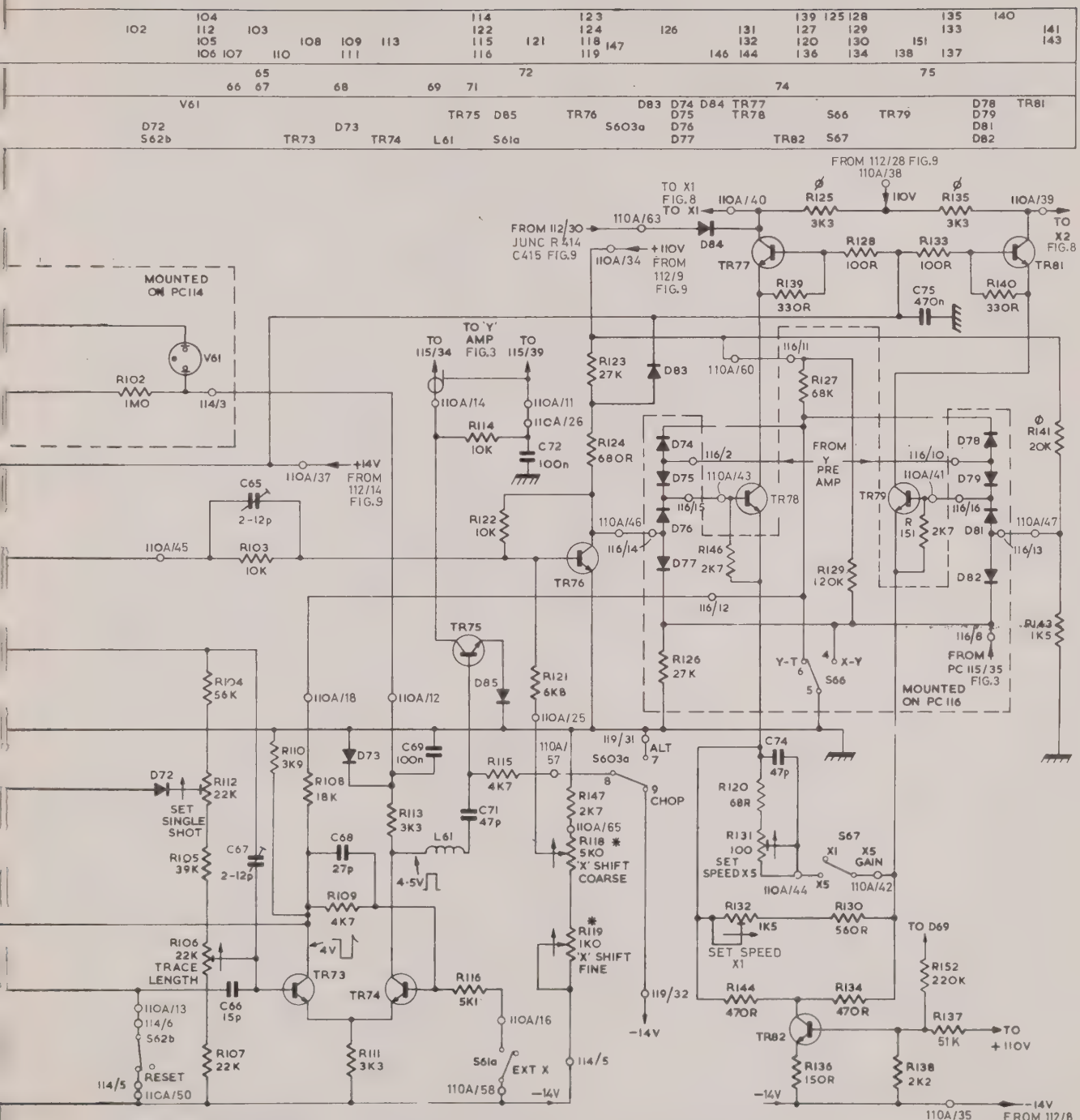
TRIGGER CIRCUIT FIG.5. D66A

RESISTORS	62 60 65 67 68 73 90 66 69 70 71 72 80 75 74 78 82 83 77 79 84 76 85 145 86 64 61 87 Rt 81 89 91 63 92 93 88 94 95 96 97 98 99 101
CAPACITORS	60 61 62 73 70 Ct 76 Ch 63 64
MISC	D64 TR64 TR62 S63 D65 TR67 TR65 TR66 D66 TR68 D67 D68 TR69 D69 TR71 TR72 D71 S61b S62a



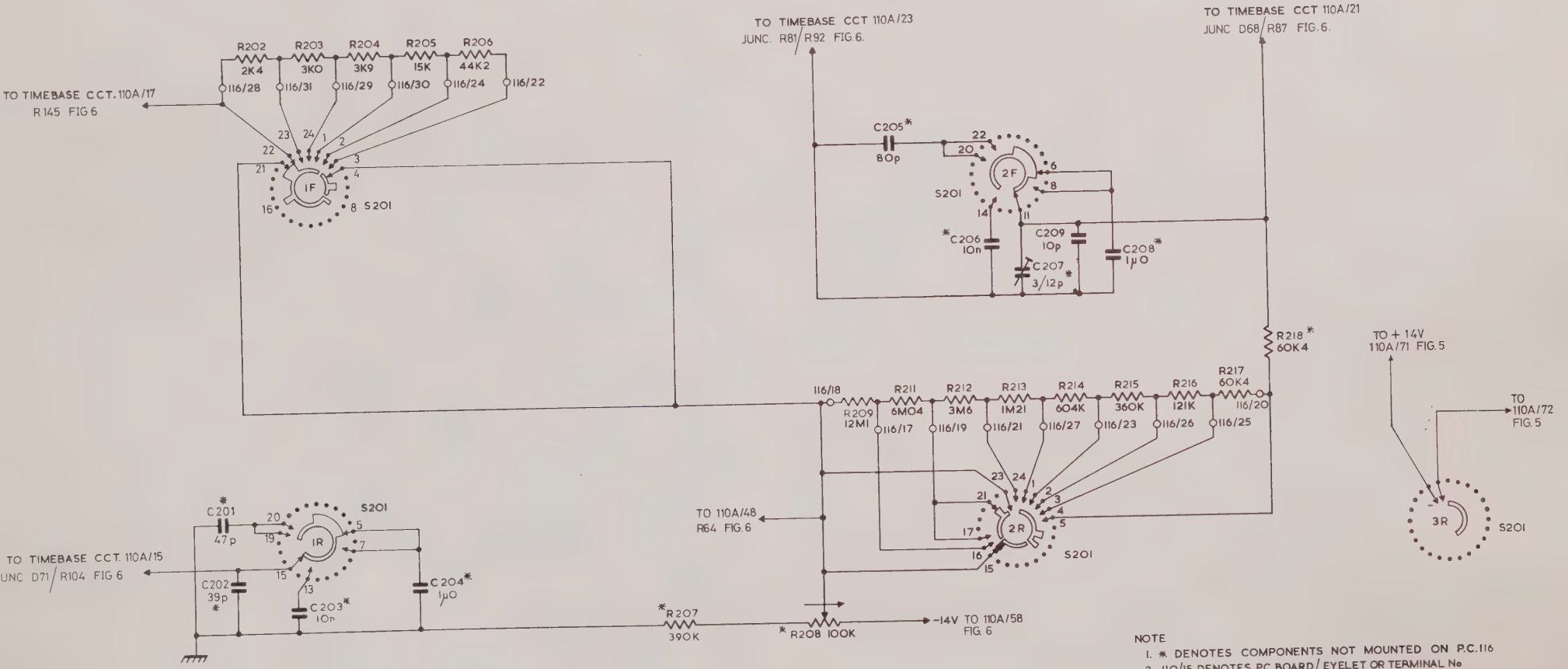
NOTES.
1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD
2. 110A/73 DENOTES PC BOARD/EYELET OR TERMINAL No.

TIMEBASE X-AMP

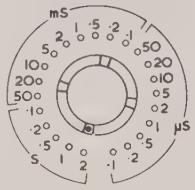


& BLANKING FIG. 6 D66A

RESISTORS		202	.203	204	205	206		207		208	209	211	212	213	214	215	216	217	218
CAPACITORS	201 202		203		204							205		206	207	209	208		



NOTE
1. * DENOTES COMPONENTS NOT MOUNTED ON P.C.116
2. 110/15 DENOTES PC BOARD/EYELET OR TERMINAL No

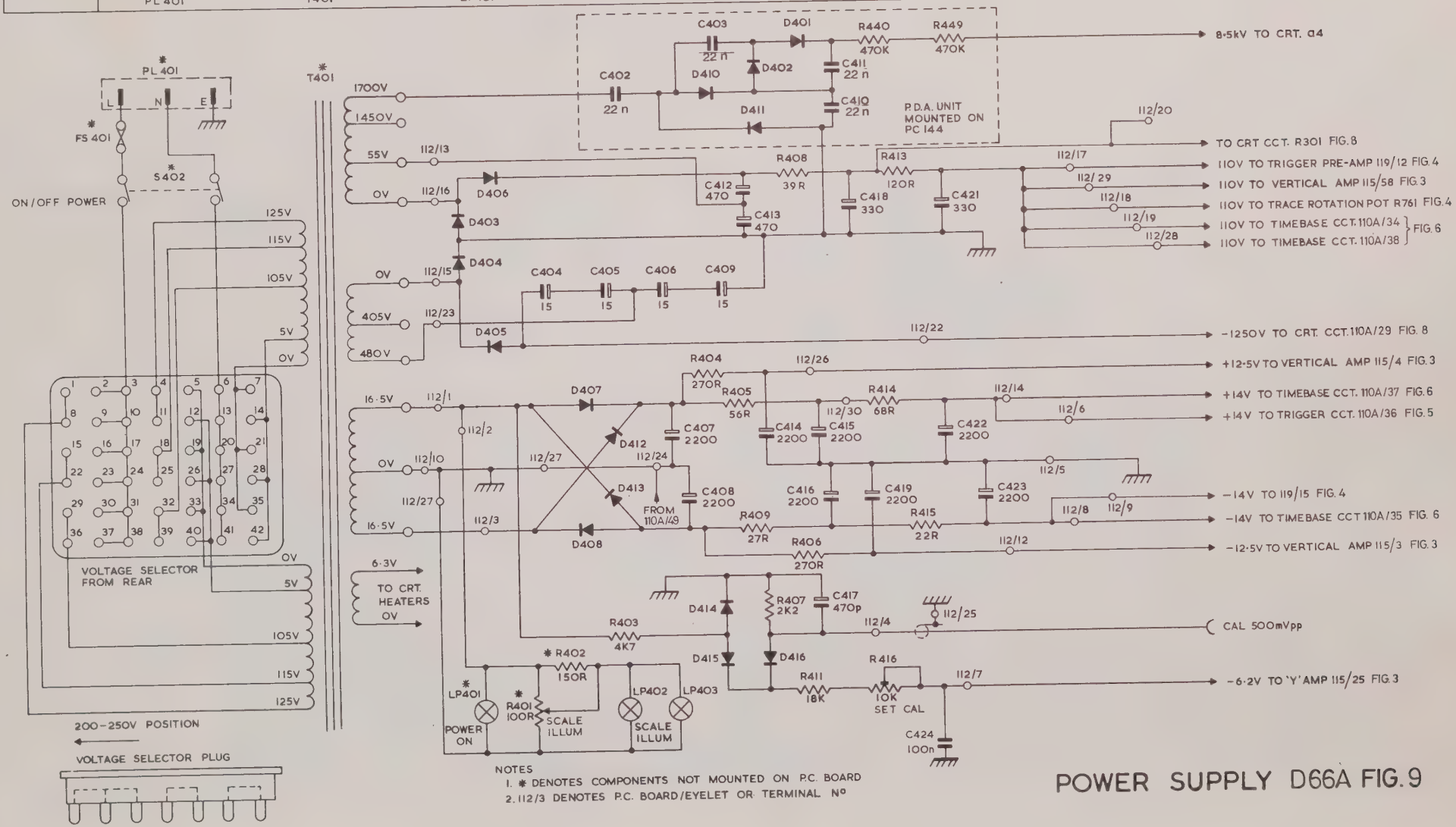


TIME/DIV SWITCH POSITIONS.
SWITCH SHOWN IN FULLY
ANTI-CLOCKWISE POSITION.

TIME / DIV. SWITCH D66A
FIG. 7

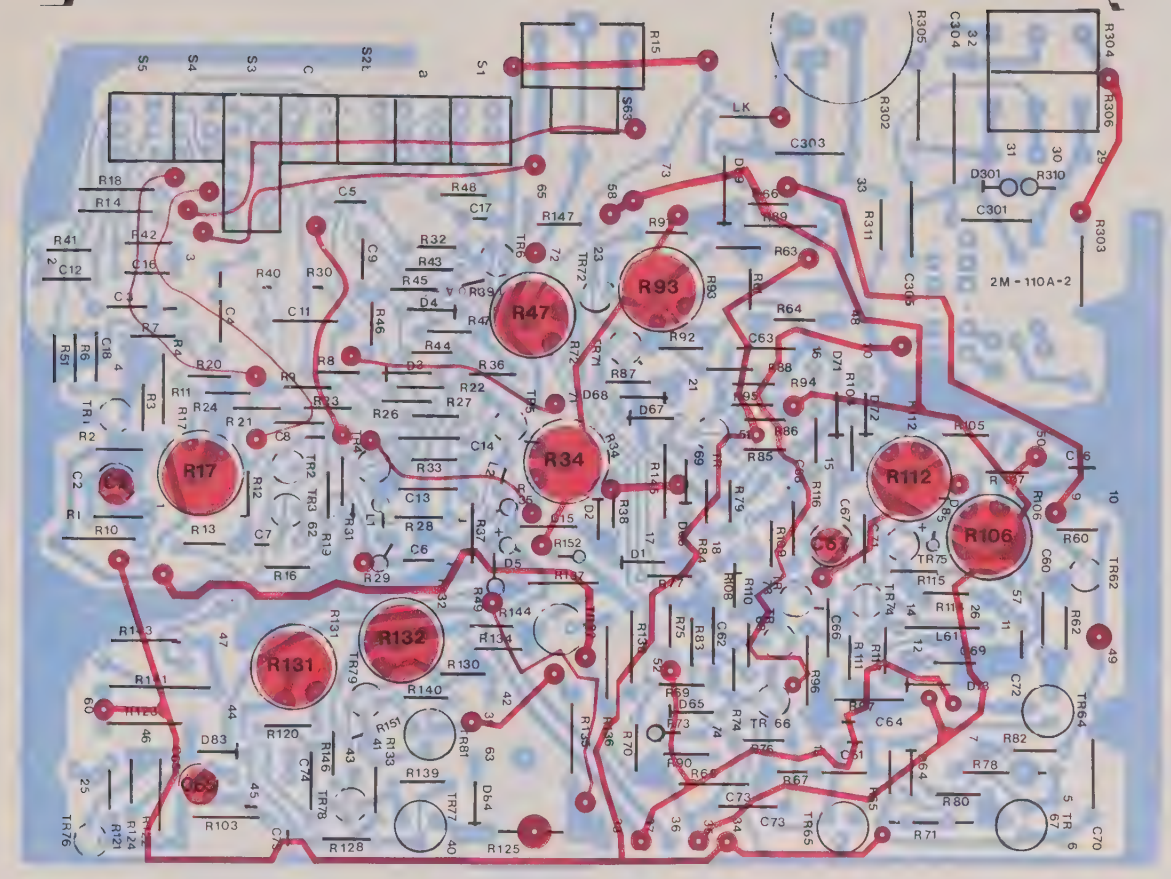
| | | |

RESISTORS	401 402 403 404 405 408 409 406 407 411 440 413 449 414 415 416
CAPACITORS	402 404 405 403 406 409 407 408 413 412 414 415 411 416 410 418 424 421 417 419 422 423
MISC	S402 FS401 PL401 T401 D403 D404 D406 D405 D407 D408 D412 D413 LP401 LP402 LP403 D410 D414 D415 D402 D411 D416 D401

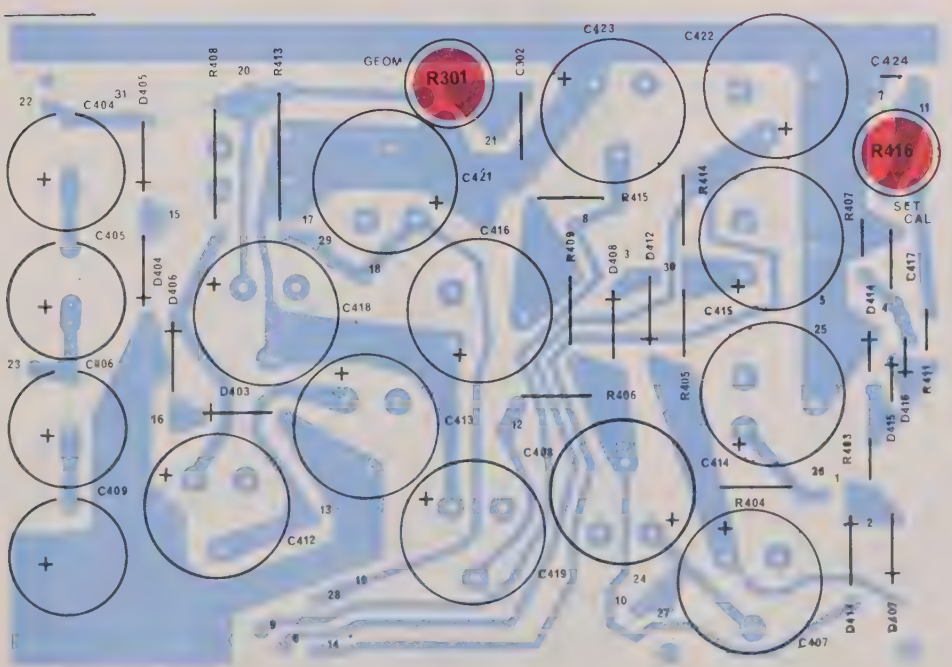


NOTES
1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD
2. 112/3 DENOTES P.C. BOARD/EYELET OR TERMINAL Nº

POWER SUPPLY D66A FIG. 9



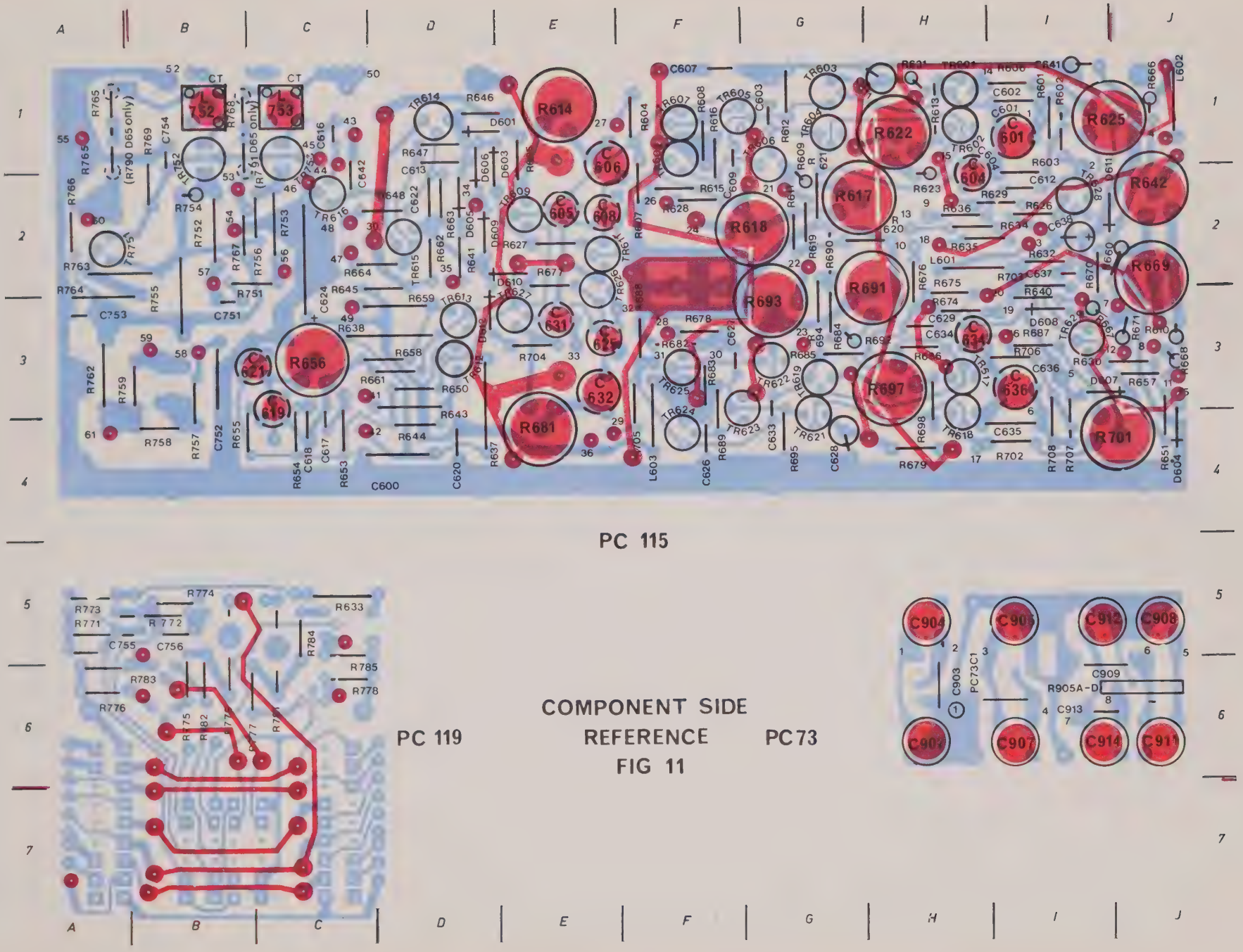
PC 110A



PC 112

COMPONENT REFERENCE

FIG 10


PC 115
PC 119
COMPONENT SIDE
REFERENCE PC73
FIG 11

SECTION 7
STANDARD OPTIONS

If the standard D66A instrument to which this manual applies has been supplied with one or more of the Standard Options listed below, the appropriate technical data must be used in conjunction with the standard manual information.

Option 4	P7 CRT (Part Number 154-0669-00) and amber filter (Part Number 378-0605-06) fitted in place of standard P31 tube, and grey filter.
Option 6	For operation on 115V line voltage and fitted with USA power cord (Part Number 161-0085-00)

0 1 2 3 4 5 6 7 8 9 0

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